Responsiveness Summary

Lower Fox River and Green Bay, Wisconsin Site

Record of Decision, Operable Units 1 and 2

Wisconsin Department of Natural Resources
101 S. Webster Street
Madison, Wisconsin 55703

Wisconsin Department of Natural Resources
Northeast Region
1125 N. Military Avenue
Green Bay, Wisconsin 54307

U.S. Environmental Protection Agency
Region 5 Superfund
77 W. Jackson Boulevard
Chicago, Illinois 60604

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List of White Papers

List of Acronyms

AEHS	Association for Environmental Health and Sciences
Agencies	United States Environmental Protection Agency and Wisconsin Department of Natural Resources
AGI	American Geological Institute
API	Appleton Papers, Inc.
API Panel	Appleton Paper, Inc. Panel
ARAR	applicable or relevant and appropriate requirement
ARCS	Assessment and Remediation of Contaminated Sediments
ATSDR	Agency for Toxic Substances and Disease Registry
BBL	Blasland, Bouck & Lee
BCC	Bioaccumulative Chemical of Concern
BDAT	Best Demonstrated Available Technology
Be-7	beryllium-7
BLRA	Baseline Human Health and Ecological Risk Assessment
BOD	biochemical oxygen demand
BTAG	Biological Technical Assistance Group
CDF	confined disposal facility
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cm	centimeter
COC	chemical of concern
COPC	chemical of potential concern
Cs-137	cesium-137
CSF	cancer slope factor
CTE	central tendency exposure
CWA	Clean Water Act
CWAC	Clean Water Action Council
cy	cubic yard
DDE	4,4'-dichlorodiphenyl dichloroethylene
DDT	4,4'-dichlorodiphenyl trichloroethylene
DO	dissolved oxygen
ED	exposure duration
EIS	Environmental Impact Statement
EPA	United States Environmental Protection Agency
ESA	Endangered Species Act
FERC	Federal Energy Regulatory Commission
FHTB	Fort Howard Turning Basin
FRDB	Fox River Database
FRFood	Fox River Food Chain Model
FRG	Fox River Group
FRRAT	Fox River Remediation Advisory Team
FS	Feasibility Study
ft/s	feet per second
GBFood	Green Bay Food Chain Model

List of Acronyms

GBMBS	Green Bay Mass Balance Study
GBTOXe	Enhanced Green Bay PCB Transport Model
g/cy	grams per cubic yard
GFT	glass furnace technology
GLNPO	Great Lakes National Program Office
GLWQI	Great Lakes Water Quality Initiative
g/m^2	grams per square meter
GRA&I	Government Report Announcements and Index
HIS	Habitat Suitability Index
HHRA	Human Health Risk Assessment
HTTD	high-temperature thermal desorption
IDW	inverse-distance-weighing
IFIM	In-Stream Flow Incremental Methodology
IGP	Intergovernmental Partnership
ISC	*in-situ* capping
kg	kilogram
LaMP	Lake-wide Management Plan
LOAEL	lowest observed adverse effects level
LOD	limit of detection
LTI	Limno-Tech, Inc.
LTMP	Long-term Monitoring Plan
MDR	Model Documentation Report
MEP	model evaluation process
mgd	million gallons per day
mg/kg	milligrams per kilogram
MNR	Monitored Natural Recovery
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
NAS	National Academies of Science
NCP	National Contingency Plan
NEPA	National Environmental Policy Act
ng/L	nanograms per liter
NOAA	National Oceanic and Atmospheric Administration
NOAEL	no observed adverse effects level
NPL	National Priorities List
NRC	National Research Council
NRDA	Natural Resources Damage Assessment
OSWER	Office of Solid Waste and Emergency Response
OU	Operable Unit
Panel Report	Ecosystem-Based Rehabilitation Plan
PCB	polychlorinated biphenyl
PKC	Protein Kinase C
POTW	publicly-owned treatment works
ppm	parts per million
Proposed Plan	Proposed Remedial Action Plan

List of Acronyms

PRP	Potentially Responsible Party
QA/QC	quality assurance/quality control
RAGS	Risk Assessment Guidance for Superfund
RAL	Remedial Action Level
RAO	Remedial Action Objective
RAP	Remedial Action Plan
RD/RA	remedy design and remedial action
RfD	reference dose
RI	Remedial Investigation
RI/FS	Remedial Investigation and Feasibility Study
RME	reasonable maximum exposure
ROD	Record of Decision
RS	Responsiveness Summary
RSS	Root-Sum-of-Squares
SAV	submerged aquatic vegetation
Site	Lower Fox River and Green Bay Site
SITE	Superfund Innovative Technology Evaluation
SMU	Sediment Management Unit
SQT	Sediment Quality Threshold
STAC	Science and Technical Advisory Committee
SWAC	Surface-Weighted Average Concentration
T&E	threatened and endangered
TAG	Technical Assistance Grant
TBC	To be Considered
TEF	toxic equivalency factor
TEQ	toxic equivalency
TM	Technical Memorandum
TM2g	Technical Memorandum 2g
TM5c	Technical Memorandum 5c
TM7c	Technical Memorandum 7c
TMDL	total maximum daily load
TMWL	The Mountain-Whisper-Light Statistical Consulting
TOC	total organic carbon
TRV	toxicity reference value
TSCA	Toxic Substances Control Act
TTA	Time Trends Analysis
UCL	upper confidence limit
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WAC	Wisconsin Administrative Code
WDNR	Wisconsin Department of Natural Resources
WHO	World Health Organization
WLA	waste load allocation
wLFRM	Whole Lower Fox River Model

List of Acronyms

Work Plan	Work Plan to Evaluate the Fate and Transport Models for the Fox River and Green Bay
WPDES	Wisconsin Pollutant Discharge Elimination System
WQBEL	Water Quality Based Effluent Limits
WQS	Water Quality Standards
WTMI	formerly Wisconsin Tissue
WUATM	Wisconsin Department of Natural Resource’s Urban Air Toxics Monitoring
ww	wet weight
WWTF	wastewater treatment facility

Executive Summary

This *Responsiveness Summary – Lower Fox River and Green Bay, Wisconsin Site Record of Decision, Operable Units 1 and 2* (RS) is the culmination of the comment process for the Wisconsin Department of Natural Resource's (WDNR's) and the United States Environmental Protection Agency's (EPA's) *Proposed Remedial Action Plan, Lower Fox River and Green Bay* (Proposed Plan) and the *Remedial Investigation for the Lower Fox River and Green Bay, Wisconsin* (RI) and *Feasibility Study for the Lower Fox River and Green Bay, Wisconsin* (FS). These documents have had the benefit of an extensive public-involvement program. Even before the initiation of the formal public comment period, there had been numerous meetings/forums with the public.

In February 1999, a draft RI/FS was released with a 45-day public comment period, which was extended an additional 60 days. Public meetings and Proposed Plan availability sessions were announced to the public at a press conference on October 5, 2001, and received extensive coverage through television, radio, and newspaper stories. Copies of the various supporting reports and the Proposed Plan were made available to the public during a public comment period that began on October 5, 2001 and concluded on January 22, 2002.

The final RI/FS and Proposed Plan were formally presented at public meetings held on October 29, 2001 in Appleton, Wisconsin and October 30, 2001 in Green Bay, Wisconsin, where oral and written comments were accepted. Additionally, WDNR and EPA mailed meeting reminders and Proposed Plan summaries to the 10,000-name Lower Fox River mailing list recipients. Press releases pertaining to the Proposed Plan, comment period, and public meetings were also sent to newspapers, television and radio stations throughout the Fox River Valley.

Newspaper advertisements were placed in the *Green Bay Press Gazette* and the *Appleton Post Crescent* announcing the availability of the Proposed Plan and its supporting documents, and a brief summary of the Proposed Plan was placed in the information repositories. The Proposed Plan, the RI/FS, and other supporting documents containing information upon which the proposed alternative was based were also made available on the WDNR's website. In response to this public outreach, WDNR and EPA received approximately 4,800 written comments via letter, fax, and e-mail.

It was through this extensive effort that WDNR and EPA-derived the remedial action plan set forth in the Record of Decision (ROD), which is being released at this time and to which this RS is attached.

What follows in this Executive Summary is an abbreviated discussion of some of the comments addressed and responded to in the RS, beginning with the background and description of the Lower Fox River and Green Bay Site and salient elements of the ROD. For each, a more detailed discussion can be found within the main body of this RS.

Site Description and Background

The Lower Fox River (River) and Green Bay (Bay) Site includes an approximately 39-mile stretch of the Lower Fox River and the Bay to its entry into Lake Michigan (Site). The River portion of the Site extends from the outlet of Lake Winnebago and continues downstream to the River's mouth at Green Bay, Wisconsin. The Bay portion of the Site includes all of Green Bay from the city of Green Bay to the point where Green Bay enters Lake Michigan.

For many years along the River, there have been and continue to be located an intense concentration of paper mills. Some of these mills operated de-inking facilities in connection with the recycling of paper. Others manufactured carbonless copy paper. In both the de-inking operations and the manufacturing of carbonless copy paper, these mills handled polychlorinated biphenyls (PCBs), which were used in the emulsion that coated carbonless copy paper. In the de-inking process and in the manufacturing process, PCBs were released from the mills to the River directly or after passing through local water treatment works. PCBs have a tendency to adhere to sediment and, consequently, have contaminated the River sediments. In addition, the PCBs and contaminated sediments were carried downriver and into the Bay.

For ease of management and administration, the Site has been divided into certain discrete areas (Operable Units [OUs]). The River has been divided into OUs 1 through 4 and Green Bay constitutes OU 5. These OUs are as follows:

- OU 1 – Little Lake Butte des Morts
- OU 2 – Appleton to Little Rapids
- OU 3 – Little Rapids to De Pere
- OU 4 – De Pere to Green Bay
- OU 5 – Green Bay

Record of Decision

This ROD selects a remedial action for OUs 1 and 2. A second ROD, addressing OUs 3 through 5, also will be issued in the future. The estimated cost for the remedial action in OU 1 is $66.2 million and for OU 2 it is $9.9 million.

As with many Superfund sites, the problems presented by the Site are complex. The Proposed Plan, released in October 2001, recommended a cleanup plan for all five OUs at the Site. The RI/FS and the *Baseline Human Health and Ecological Risk Assessment for the Lower Fox River and Green Bay, Wisconsin Remedial Investigation and Feasibility Study* (BLRA) also cover all five OUs. The reasons for issuing an ROD at this time for only OUs 1 and 2 are as follows:

- OUs 1 and 2 represent a smaller portion of the area within the River where remediation is necessary. These two OUs represent approximately 6.5 percent of the PCB mass and 18 percent of the sediment volume in the River. Consequently, these two OUs represent a project of more manageable size than conducting all of the remediation at one time.

- To provide a phased approach to the remedial work, work on upstream areas can start before the downstream areas, which is consistent with EPA policy.

- Planning for OUs 3, 4, and 5 may benefit from knowledge gained from the remedial activities conducted for the OUs 1 and 2 project.

This ROD addresses human health and ecological risks posed to people and ecological receptors associated with PCBs that have been released to the Site. Presently, these PCBs reside primarily in the sediments in the River and in the Bay, and this ROD outlines a remedial plan to address a certain portion of PCB-contaminated sediments. Removal of PCB-contaminated sediments will result in reduced PCB concentrations in fish tissue, thereby accelerating the reduction in potential future human health and ecological risks. In addition, by addressing upstream contamination first, the downstream transport of PCBs will be dramatically reduced and will not interfere with further remediation efforts downstream.

Presently, it is estimated that OU 1 contains approximately 4,070 pounds (1,850 kilograms [kg]) of PCBs in 2,200,400 cubic yards (cy) of sediment. The ROD provides for the removal by hydraulic dredging of an estimated 784,000 cy of contaminated sediments from OU 1. The dredged material will be mechanically “dewatered” and taken to a landfill for permanent disposal. The ROD establishes an “action level” of 1 part per million (ppm) for this cleanup effort. In other words, any sediment found in OU 1, which has a concentration of PCBs of 1 ppm or greater, will be targeted for removal. The goal of the remedial action in OU 1 is to reach a surface-weighted average concentration (SWAC) of less than 0.25 ppm after dredging is completed. This means that the concentration of PCBs averaged over the entire OU will not exceed 0.25 ppm when the cleanup is complete. By reducing the concentration of PCBs in OU 1 to the SWAC level, or below, will dramatically reduce the human health and ecological risk.

Operable Unit 2, which is about 22 miles in length, contains approximately 240 pounds (109 kg) of PCBs in 339,200 cy of sediment. A significant portion of the PCBs contained in this OU have already been removed during the sediment removal demonstration project at Deposit N. The result is that in OU 2 there remain no significant (i.e., greater than 10,000 cy) contaminated sediment deposits with concentrations of PCBs above the action level. Moreover, it is contemplated that the farthest downstream deposit in OU 2 (Deposit DD) may be remediated in connection with the remedial action to be undertaken in OU 3 at a later time. Even without active remediation, the SWAC for OU 2 is low, approximately 0.61 ppm, which is below the remedial action objective (RAO) of 1 ppm. Therefore for OU 2 the ROD selects a remedy of monitored natural recovery (MNR). This remedy does not involve sediment removal. Rather, it consists of a comprehensive monitoring program designed in part to monitor the levels of PCBs in sediments as the natural recovery processes work. Coupling this MNR with the substantial upstream dredging remedy in OU 1 should result in very minimal human health or ecological risk in OU 2.

Comments and Responses

Policy Issues

Many comments were received regarding policy issues and selection of the preferred remedy. In 2001, the National Research Council (NRC) issued findings addressing the complex issues associated with the managing of PCB-contaminated sediment sites. EPA issued guidance in 2002 for managing risks at contaminated sediment sites. The Lower Fox River and Green Bay Site RI/FS and its supporting documents and actions are consistent with the principles defined by the EPA and with the NRC recommendations contained in *A Risk Management Strategy for PCB-contaminated Sediments*. Each of the 11 EPA principles and how they were applied to the Lower Fox River and Green Bay RI/FS are fully set forth in *White Paper No. 10 – Applicability of the NRC Recommendations for PCB-Contaminated Sites and EPA's 11 Management Principles*.

In the review of comments, the WDNR and EPA (Agencies) concluded that there is merit in adopting an adaptive management approach for dealing with the complex remediation of the Lower Fox River and Green Bay. Splitting the overall Site remediation plan into two RODs will allow for a phased approach. Issuing the ROD for OUs 1 and 2 at this time and then issuing an ROD for OUs 3 through 5 at a later date will allow the Agencies to apply any "lessons learned" on OUs 1 and 2 for implementing or modifying remedies for OUs 3 through 5. The Agencies also believe that by including the consideration of a capping alternative, the flexibility of this ROD is enhanced in a manner consistent with an adaptive management approach.

Time Trends Analysis

Many comments were received regarding the comprehensive time trends analysis (Time Trends Analysis [TTA]) conducted for the RI (Appendix B). Criticisms generally followed those in the analyses presented in two papers submitted in rebuttal to the TTA: *BB&L Report on PCB Trends in Fish from the Lower Fox River* and *Time Trends in PCB Concentrations in Sediment and Fish, Lower Fox River, Wisconsin* by Dr. Paul Switzer.

Issues raised by commenters included the following:

- Declines in PCB concentrations in fish tissue, sediments, and water were not used or improperly applied in the RI/FS and Proposed Plan;
- That there was no basis for the breakpoint established in the TTA, which shows a leveling off of fish tissue concentrations (the “breakpoint analysis”);
- Alternatively, commenters contended that PCB concentrations in fish tissue are continuing to show decline within the River; and
- Further, the TTA used an inappropriate statistical model, did not make the best use of the available data, and that a simple mathematical representation of the data shows a long-term, consistent downward trend.

Central to these arguments is that the selection of the remedial activities would be inappropriately based on this analysis in the TTA. WDNR and EPA address these criticisms in both the response to comments and in *White Paper No. 1 – Time Trends Analysis*. As these responses show, the TTA analysis is appropriate, and WDNR and EPA have correctly relied upon it.

Economic Impacts

Numerous commenters expressed concern about local economic impacts on the Fox River Valley of a large-scale, expensive remedial action in the River. WDNR and EPA share these concerns about the potential impacts that this action, as well as future actions, may have on the Fox River Valley and Green Bay community. Furthermore, WDNR and EPA believe that one of the keys to minimizing remedial costs is to work with the local community and businesses. To begin to address these concerns, the WDNR has supported legislation to indemnify municipal landfills and public-owned treatment works (POTWs) that accept sediment and leachate from sediment remediation projects (S. 292.70 Wisconsin State Statutes). EPA has publicly stated that it may invoke its enforcement discretion to reduce the economic burden on the Fox River Valley municipalities. In addition, EPA has completed an economic assessment of the capability of those entities, identified as potentially responsible parties (PRPs), to fund the work called for in the ROD. EPA’s analysis is contained *White Paper No. 17 – Financial Assessment of the Fox River Group*. The major conclusion of that assessment was that those entities can collectively shoulder the costs of this remedy without financial hardship.

Alternative Remediation Plans

As part of the submittals during the public comments period, WDNR and EPA received an alternative remediation plan from a panel of university professors and scientists, experts hired by Appleton Papers, Incorporated (API) entitled *Ecosystem-Based Rehabilitation Plan – An Integrated Plan for Habitat Enhancement and Expedited Exposure Reduction in the Lower Fox River and Green Bay* (the "Panel Report"). This plan focused on the feasibility of capping major portions of the River in lieu of the remedy contained in the Proposed Plan. The Agencies address this proposal in Section 5.5 of the RS and in several of the white papers (e.g., *White Paper No. 6A – Comments on the API Panel Report*; *White Paper No. 6B – In-Situ Capping as a Remedy Component for the Lower Fox River* and *White Paper No. 8 – Habitat and Ecological Considerations as a Remedy Component of the Lower Fox River*).

This alternative plan generated a number of comments, both in favor and against the Panel Report. In the RS, the Agencies address the comments regarding the Panel Report, but do not address the comments received on this alternative capping plan because that alternative plan was not part of the Agencies' Proposed Plan, and the Agencies are not the authors of that alternative plan.

Models

Numerous comments were received that questioned the models used in investigation of and derivation of the remedial alternatives. Commenters from the Fox River Group (FRG) (a coalition of six companies) submitted an alternative computer model known as FoxSim and made various claims based on the forecasts generated by FoxSim. In some cases, comparing those forecasts to the modeling work identified in the *Model Documentation Report for the Lower Fox River and Green Bay, Wisconsin* (MDR). In response to the submittal of the FoxSim model, WDNR's Water Quality Modeling Section reviewed FoxSim. The primary conclusions of that review was that the FoxSim model contains high uncertainties in its ability to predict PCB fate and transport in the Lower Fox River system, and that the FoxSim model was constructed with a stated bias to "evaluate the on-going and future natural attenuation of the system." This is accomplished through the model's prediction of deposition of clean sediments and less scour of contaminated sediments, which leads to a prediction of less availability of PCBs to the water column and transport of PCBs within the River, and from the River to Green Bay. Please see *White Paper No. 15 – FoxSim Model Documentation* for more information.

The Agencies have also reviewed comments made on the current model being used to assist in the assessment and evaluation of impacts of the remedial alternatives, the Whole Lower Fox River Model (wLFRM). The Agencies believe that they have addressed the wLFRM comments and concerns and have confidence in wLFRM model. Section 6 of this RS addresses these comments on the models used in the investigation and selection of the remedial alternatives.

RALs, SWACs, SQTs, and RAOs

WDNR and EPA selected the 1 ppm action level based on an evaluation of a range of Remedial Action Levels (RALs) with the residual SWAC for OU 1 and the ability of the action level to meet the RAOs. The RALs evaluated included no action, 0.125, 0.25, 0.5, 1, and 5 ppm. The selection of the cleanup level is the outcome of a complete and scientifically based risk evaluation. Before selecting 1 ppm, WDNR and EPA carefully considered the RAOs, model forecasts of the post remediation time required to achieve risk reduction, the post-remediation SWAC, comparison of the residual concentration to Sediment Quality Thresholds (SQTs) for human and ecological receptors, sediment volume and PCB mass to be managed, as well as cost. The 1 ppm action level represented the optimum action level for achieving these goals.

In OU 1, the post-remediation time required to reach the endpoints for risk reduction varies by receptor from less than 1 year to an estimated 29 years. As was pointed out in earlier documents (e.g., the Proposed Plan), the upstream reach achieves risk reduction faster than does the area around the mouth of the River. The SWAC in OU 1 is a measure of the surface (upper 10 centimeters [cm]) concentration and would be 0.19 ppm if all material greater than 1 ppm is removed. The SWAC value provides a number that can be compared to the SQTs developed in the BLRA. SQTs are estimated concentrations that relate risk in humans, birds, mammals, and fish with safe threshold concentrations of PCBs in sediment. A comparison of the SWAC and SQT values shows that there is an overlap of the various SQT values for recreational anglers, high-intake fish consumers, and wildlife, and the SWAC value for OU 1.

WDNR and EPA believe this is also consistent with the 1999 Draft RI/FS. The 1999 Draft RI/FS called for an action level of 0.25 ppm or a 0.25 ppm SWAC. The predicted SWAC value resulting from the 1 ppm action level is approximately 0.19 ppm in OU 1. For further discussion, please review the supporting document that explains the relationship of the action level to the SWAC; *White Paper No. 11 – Comparison of SQTs, RALs, RAOs, and SWACs for the Lower Fox River*.

Conclusion

WDNR and EPA, after extensive public involvement and input, have selected a remedy for the Site, which will achieve the RAOs as set forth in the Proposed Plan and attached ROD. The following RS represents the comments and responses from the comment period and were used in selecting the final remedy presented in the ROD.

Complete copies of the Lower Fox River and Green Bay Site ROD and RS for OUs 1 and 2 are available to the public at five public repositories in the Fox River Valley as well as being posted on the WDNR's web page for the Lower Fox River (http://www.dnr.state.wi.us/org/water/wm/lowerfox/index.html). In addition, the Administrative Record for the Site is available at the WDNR's offices in Green Bay and in Madison. Information repositories are located at the Appleton Public Library, Oshkosh Public Library, Brown County Library in Green Bay, Door County Library in Sturgeon Bay, and Oneida Community Library.

1 Legal, Policy, and Public Participation Issues

1.1 Policy Issues

Master Comment 1.1

Commenters stated that capping as a remedy for sediments contaminated with polychlorinated biphenyls exceeding the Toxic Substances Control Act (TSCA) level (50 ppm) was not included in the FS. Commenters further stated that the criteria for eliminating capping of TSCA-level sediments based on the EPA disapproval letter has no regulatory basis. The concerns raised were that EPA, in fact, may approve of TSCA capping under the risk-based disposal approval 40 Code of Federal Regulations (CFR) § 761.61((c)) as "PCB remediation waste." Further, commenters stated that TSCA does not exclude capping of any sediment area with PCB concentrations greater than 50 ppm, unless all sediments with concentrations greater than that level are removed through dredging first.

Response

WDNR and EPA agree that TSCA regulations may not prohibit capping at the Lower Fox River Site. TSCA is applicable and would be considered in the remedy selected.

The Agencies do not recommend capping in areas with PCB concentrations exceeding TSCA levels. The presence of PCBs with concentrations exceeding 50 ppm presents some constraints for capping with respect to TSCA. The ability of an *in-situ* cap to meet the requirements of TSCA has not been fully established. TSCA-level sediments are present only in limited areas of OUs 1, 3, and 4. Based on these considerations, no capping of TSCA-level sediments should be considered.

In addition, *White Paper No. 6B – In-Situ Capping as a Remedy Component for the Lower Fox River* contains a relevant discussion of this topic.

Master Comment 1.2

Commenters indicated that WDNR should support and pursue legislative protection for local governments in connection with any remediation alternatives selected for the Lower Fox River.

Response

WDNR has done this in that the Agency supported the passing of legislation to indemnify municipal landfills and POTWs that accept sediment and leachate from sediment remediation projects (S.292.70 Wisconsin State Statutes). Moreover, while a number of municipalities may technically fit within the Superfund Section 107(a) categories of "potentially responsible parties," both WDNR and EPA management have made statements publicly that the State and federal governments are not inclined to seek large dollar-figure reimbursement from those municipalities. Instead, as an exercise of its "enforcement discretion," it is much more likely that the State and federal governments may seek in-kind services and other assistance from those municipalities as a part of any settlement that may be achieved for the Lower Fox River cleanup.

1.2 CERCLA Requirements and Issues

Master Comment 1.3

Some commenters contend that the FS is required to address the potential environmental impacts in a manner that would meet the standards of "functional equivalency" in an Environmental Impact Statement (EIS) under the National Environmental Policy Act (NEPA).

Response

This very issue is dealt with in detail in the Hudson River Responsiveness Summary, Master Comment 475. In that document, EPA noted the following:

> CERCLA requires EPA to comply only with the substantive, and not the procedural, requirements of other environmental laws for CERCLA response actions that are conducted onsite (Section 121(d)(2)(A) of CERCLA, 42 U.S.C. § 9621(d)(2)(A); Section 121(e) of CERCLA, 42 U.S.C. § 9621(e); 40 CFR § 300.5 (definitions of "applicable requirements" and "relevant and appropriate requirements"); and State of Ohio v. U.S. E.P.A., 997 F.2d 1520, 1526 (D.C. Cir. 1993) (ARARs include only substantive, and not procedural, requirements). See also EPA guidance document CERCLA Compliance with Other Laws Manual: Part II, Clean Air Act and Other Environmental Statutes and State Requirements (OSWER Directive 9234.1-02 [August 1989], p. 4-1). NEPA's requirements are procedural, and, therefore, do not apply to on-site CERCLA response actions. Any dredging activity and dewatering/transfer facility for the Hudson [Lower Fox River] PCBs remedy would be considered on-site (40 CFR 300.400(e)(1)): "The term on-site means the areal extent of contamination and all suitable areas in very close proximity to the contamination necessary for implementation of the response action."
>
> Moreover, EPA stated that it considers the procedures established by the CERCLA for investigation and response at hazardous waste sites, which are further detailed in the NCP, and which were complied with during the Hudson River PCBs Reassessment, to be the functional equivalent of NEPA. This consideration is based on the extensive analysis of alternatives and environmental impacts, and the aggressive community involvement program, established by CERCLA. As a number of courts have held, where the authorizing statute (in this case, CERCLA) already provides for a detailed analysis of environmental impacts, EPA will satisfy necessary environmental review requirements by following CERCLA, and will not have to separately comply with NEPA (e.g., State of Alabama ex rel. Siegelman v. EPA, 911 F.2d 499 [11th Cir. 1990]).

> Functional equivalence does not mean structural or literal equivalence, and does not require EPA to consider every point or issue that would otherwise be addressed in an environmental impact statement (State of Alabama ex rel. Siegelman, 911 F.2d 504-505). CERCLA's substantive and procedural requirements, followed here, nevertheless ensure that EPA considers appropriate environmental issues relating to remedy selection, and allows the public to participate in the remedy selection process.
>
> Some comments argue that CERCLA and the NCP require EPA to provide detailed analyses of potential noise, odor, lighting, transportation, and resuspension impacts of the preferred remedy, and to identify the locations of the proposed dewatering/transfer facility(ies), and that such information should have been included in the FS in order to satisfy the functional equivalence standard. The analysis of potential short-term impacts of the preferred remedy in the FS, however, was performed in accordance with CERCLA and the NCP, and is, therefore, functionally equivalent to a NEPA analysis. EPA's analysis of potential short-term impacts was also consistent with EPA's *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (OSWER 9355.3-01) (October 1988).

The commenters also go on to assert that there may be adverse impacts associated with dredging, and imply that the following issues should be addressed in the FS:

- **Habitat, Wildlife, and Threatened and Endangered Species:** The Final BLRA and the FS thoroughly document that past, present, and future no-action conditions constitute a threat to wildlife and threatened and endangered (T&E) species. Locations of and potential impacts and enhancements to habitat and wildlife due to removal and capping actions are also evaluated in Section 2 of the BLRA, Section 8 of this RS, and in *White Paper No. 8 – Habitat and Ecological Considerations as a Remedy Component for the Lower Fox River*.

- Transportation issues associated with dredging projects were demonstrated to not be an important issue to the public as part of the demonstration projects at Deposit N, and at Sediment Management Units (SMUs) 56/57. These issues are addressed in the *Sediment Technologies Memorandum* (FS Appendix B), Sections 6 through 9 of the FS, and are in Section 8.3 of this RS.

- Noise associated with a removal project, like transportation, was addressed by the demonstration projects and cited in the same sections above.

- Recreational and scenic impacts are not addressed, per se, in the FS. These are considered to be short-term, temporary impacts that are necessary as part of any remedial operations.

- Landmarks and historic/archeological sites will be addressed as part of the final design process. EPA's FIELDS group has already initiated surveys within the River to determine if there are any submerged sites that may require special consideration during design.

- Governmental experience with sediment removal projects in the Lower Fox River (Deposit N, SMU 56/57) has shown that the energy needs for dredging projects are not extraordinary. While the specific projects cited above are not of the magnitude required by the ROD, they are good indicators of what energy needs will be required for the "scaled up" projects required by the ROD. Also, it should be noted that the ROD-required projects will be accomplished over a period of years so energy needs can be spread out over time. The availability of sufficient energy resources to conduct the ROD-required projects will be considered during the Remedial Design phase of the cleanup project.

- Air quality was again addressed as part of the two demonstration projects. During remediation of the most highly contaminated sediments in the entire Lower Fox River (SMU 56/57), volatilization did not reach a level that posed a risk to human health. The FRG (BBL, 2000) even concluded that: "Although increases in ambient air PCB concentrations were observed near the sediment dewatering area, estimated PCB emissions and resulting concentrations were found to be relatively small and insignificant relative to human exposure and risk."

- Water quality issues were also addressed in the two demonstration projects and shown to be a minimal issue. Water quality impacts are also addressed in *White Paper No. 7 – Lower Fox River Dredged Sediment Process Wastewater Quality and Quantity: Ability to Achieve Compliance with Water Quality Standards and Associated WPDES Permit Limits* in this RS.

- Wetlands are addressed within the BLRA, the FS, and in *White Paper No. 8 – Habitat and Ecological Considerations as a Remedy Component for the Lower Fox River* of this RS. It is unclear as to which wetlands the commenters are referring to as being impacted during the implementation of the remedy. Although removal is proposed in shallow water, the RI, BLRA, and FS clearly illustrate that the proposed remediation does not overlap with identified wetlands.

Reference

BBL, 2000. Major Contaminated Sediment Site Database. Last updated August 1998. Website. http://www.hudsonwatch.com.

Master Comment 1.4

A commenter stated that a 1 ppm RAL is inappropriate and arbitrary because it was selected without considerations of dredging feasibility, cost, or risk, or reach-specific approaches to cleanup levels.

Response

The selection of the 1 ppm RAL is not arbitrary. In selection of the RAL, WDNR and EPA considered RAOs, model forecasts of the time necessary to achieve risk reduction, the post-remediation SWAC, comparison of the residual concentration to SQTs for human and ecological receptors, as well as sediment volume and PCB mass to be managed as well as the cost. This is discussed in more detail in Section 9.6 of the Proposed Plan.

Multiple RALs were considered for each OU, which include no action and action levels ranging from 0.125, 0.25, 0.5, 1, and 5 ppm. Model forecasts were used to compare the projected outcomes of the remedial alternatives using various action levels with the RAOs, primarily RAOs 2 and 3, which deal with protection of human health and the environment. On the basis of that analysis and to achieve the risk reduction objectives using a consistent action level, 1 ppm was agreed upon as the appropriate RAL.

In OU 1, the time needed to reach the endpoints for risk reduction varies by receptor from less than 1 year to an estimated 29 years. As was pointed out in earlier documents (e.g., the Proposed Plan), the upstream reach achieves risk reduction faster than does the area around the mouth of the River. The SWAC in OU 1 is a measure of the surface (upper 10 cm) concentration and would be 0.19 ppm if all material greater than 1 ppm can be removed. The SWAC value provides a number that can be compared to the SQTs developed in the BLRA. SQTs are estimated concentrations that link risk in humans, birds, mammals, and fish with safe threshold concentrations of PCBs in sediment. A comparison of the SWAC and SQT values shows that there is overlap of the various SQT values for recreational anglers, high-intake fish consumers, and wildlife, and the SWAC values for OU 1.

The 1 ppm action level results in the removal of a significant volume of contaminated sediment and PCB mass from OU 1 at an estimated cost of $66.2 million. Note that this figure does not include the additional cost of $9.9 million for MNR in OU 2, which increases the total cost of the remedy for OUs 1 and 2 to $76.1 million.

Based on the above, WDNR and EPA disagree with the view expressed in this comment. The basis for the selection of the technology and the RAL in the remedy for the Lower Fox River is clearly stated in the Proposed Plan. Feasibility, cost, risk, and reach-specific approaches were all considered and are covered in the RI/FS, BLRA, and the MDR that support the Proposed

Plan. These considerations are also part of the Superfund evaluation process (i.e., the “nine criteria” comparisons and evaluations).

Master Comment 1.5

Commenters suggested that the Agencies do a better job of citing both legal and health reasons for pursuing this cleanup and make it clear that government has no choice but to enforce the law.

Response

WDNR and EPA believe that health concerns and legal citations are adequately addressed. Human health effects are clearly discussed in both the Executive Summary and the human health portion of the BLRA, as well as Section 6 of the Proposed Plan.

The legal issues do compel that these actions be undertaken. These are from the federal Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) law and the federal National Contingency Plan (NCP) found at 40 CFR Part 300. Action is required at Superfund sites through CERCLA, which is also known as the Superfund law. This is a national program enacted by Congress in 1980. Superfund requires that EPA identify responsible parties or contributors to the contamination. These groups or individuals are known as PRPs, and can include the owners and operators of the facility or property, persons who transported or arranged for waste to be taken to the contaminated site, and waste generators.

CERCLA created a tax on chemical and petroleum businesses, and money collected from the tax went into a large trust fund known as “Superfund.” Superfund was created to pay for the cleanup of the country’s worst waste disposal and hazardous substances spill sites that endangered human health and/or the environment. The EPA administers Superfund in cooperation with individual states. The WDNR coordinates Wisconsin’s involvement in Superfund.

CERCLA does mandate that PRPs are liable for addressing contamination at the site. Through legal action, EPA may pursue cost recovery for any tax dollars spent on remediation.

With a Superfund site, the public often participates through public meetings or by submitting comments on the plans. The public may also be informed through newsletters, direct mailings, or interviews with state/federal agency staff, and other means. All of these methods have been used at the Lower Fox River Site and two technical assistance grants totaling $100,000 have been provided to the Clean Water Action Council (CWAC).

For more information on the federal Superfund Program in Wisconsin, please visit the WDNR web page at: http://www.dnr.state.wi.us/org/aw/rr/archives/pubs/RR122.pdf.

Master Comment 1.6

Commenters stated that they would prefer a prompt State-managed remedial action, based on a settlement of claims and defenses with the paper mills, before the issuance of an ROD and without formal NPL listing. These sentiments include the need for long-term cooperation among all entities; that timeliness in commencing cleanup is a key to success and delay is not beneficial; that CERCLA focuses on liability and protecting legal rights; that litigation diverts resources; and settlement will provide greater public confidence in the remedy.

Response

WDNR and EPA agree with the sentiments expressed here concerning the need for timely cleanup, avoiding delays and litigation, and that a negotiated settlement is the preferred method provided the remedial option is protective of human health and the environment. The Agencies also agree with the statement on the CERCLA processes and believe it is important to ensure that the rights of all parties are protected.

The Agencies agree that cooperation among all parties is necessary and desirable to moving the Lower Fox River Site to a better and faster resolution and cleanup. However, the Agencies believe that the Superfund process helps, not hinders, that approach. The focus of CERCLA is protection of human health and the environment through the cleanup and remediation of environmental hazards, not litigation. By going through the CERCLA process, a complete analysis of the nature and extent of the contamination is conducted and the remediation is clearly set forth in the ROD so that the public knows what will be done at the site. If the parties responsible for the contamination choose not to cooperate in the remediation of the site, then CERCLA provides the enforcement tools necessary to compel their action. Thus, while the Agencies agree that cooperation among all interested parties is needed at the Lower Fox River Site, the Agencies believe that the CERCLA Superfund process, from the proposed listing to the ROD, with the possibility of litigation if needed, helps rather than hinders the quick and proper cleanup of the Lower Fox River Site.

Master Comment 1.7

Commenters suggested that the Agencies should include in the ROD adaptive management and project management approaches for dealing with the complex remediation of the Lower Fox River.

Response

WDNR and EPA are taking a phased approach. The Agencies are issuing an ROD for OUs 1 and 2 at this time and expect to issue an ROD for OUs 3 through 5 at a later time. The Agencies plan to use any "lessons learned" on OUs 1 and 2 for implementing or modifying remedies for OUs 3 through 5.

Consistent with adaptive management and adaptive project management principles, WDNR and EPA have sought to introduce a degree of flexibility into the Lower Fox River ROD, consistent with recent guidance by EPA. On February 12, 2002, Assistant Administrator Marianne Lamont Horinko issued a memorandum entitled "Principles for Managing Contaminated Sediment Risks at Hazardous Waste Sites" (Principles). Among other things, that document encourages ROD decisions to adopt an "iterative approach" in a risk-based framework. Specifically, principle number 5 states: "EPA encourages the use of an iterative approach, especially at complex sediment sites." And, further, "At complex sediment sites, site managers should consider the benefits of phasing the remediation." Moreover, the NCP, at 300 CFR § 430(a)(1)(ii), states:

> **Program Management Principles.** EPA generally should consider the following general principles of program management during the remedial process:
>
> (A) Sites should generally be remediated in operable units when…phased analysis and response is necessary or appropriate given the size or complexity of the site…

In adding the "Contingent Remedy" to the ROD (see Section 13.4), and in selecting a remedy for OUs 1 and 2 only, WDNR and EPA have sought to create the ROD flexibility described in the Principles memorandum and the NCP. Such flexibility will allow for "mid-course corrections" in the selected remedy based on what is learned from remedial activities undertaken early in the process.

1.3 Applicability of NAS/NRC and 11 Principles

Master Comment 1.8

Commenters complained that the Agencies have disregarded the key recommendations of the NAS NRC report. The Draft FS does not seriously consider the risks posed by PCB-contaminated sediment left behind at the surface after dredging, the risks posed by PCBs released to the water column during dredging, and the eco-risks on habitat and food web. Commenters further complained that a decision to select the proposed remedy would be arbitrary and capricious and not in accordance with law. Further, another commenter suggested that the Proposed Plan fails to meet NCP criteria and, therefore, was unlawful.

Response

NCP criteria require that the remedy selection process involve the evaluation of alternative remedial actions using the following nine criteria:

- **Threshold Criteria**
  - Overall protection of human health and the environment; and
  - Compliance with applicable or relevant and appropriate requirements (ARARs).
- **Primary Balancing Criteria**
  - Long-term effectiveness and permanence;
  - Reduction of toxicity, mobility, or volume;
  - Short-term effectiveness;
  - Implementability; and
  - Cost.
- **Modifying Criteria**
  - State acceptance; and
  - Community acceptance (40 CFR § 300.430 (e)(9)(iii)).

These nine criteria were evaluated for the Lower Fox River. In addition, the Lower Fox River and Green Bay RI/FS report is consistent with the 11 guiding principles defined by the EPA (EPA, 2002), which are consistent with the NCP criteria and NRC recommendations contained in *A Risk Management Strategy for PCB-contaminated Sediments* (NRC, 2001). Each of the 11 EPA principles and how they were applied to the Lower Fox River and Green Bay RI/FS are fully set forth in *White Paper No. 10 – Applicability of the NRC Recommendations for PCB-Contaminated Sediment Sites and EPA's 11 Contaminated Sediment Management Principles*, and are summarized below.

Control Sources Early – Through the WDNR's Wisconsin Pollution Discharge Elimination System (WPDES) program and the discontinued use of PCBs in the production of carbonless copy paper, point source introduction of PCBs into the Lower Fox River has essentially been eliminated.

Involve the Community Early and Often – Community involvement has been a critical component of all aspects of this process.

Coordinate with States, Local Governments, Tribes, and Natural Resource Agencies – WDNR, EPA, United States Fish and Wildlife Service (USFWS), National Oceanic and Atmospheric Administration (NOAA), and the Oneida and Menominee Indian tribes signed a Memorandum of Understanding (MOU) to coordinate early with local governments, tribes, and other Natural

Resource Trustees to ensure that all relevant information and viewpoints are being considered when making remedial decisions.

Develop and Refine a Conceptual Site Model that Considers Sediment Stability – The Lower Fox River and Green Bay fate/transport models and food web models (Fox River Food Model [FRFood] and Green Bay Toxics Model [GBTOXe]) are mathematical representations of river hydrodynamics and biota exposure and effect scenarios.

Use an Iterative Approach in a Risk-Based Framework – The risk assessment process implemented for the Lower Fox River and Green Bay followed NRC and EPA recommendations by using a flexible, iterative, and tiered approach, which involved risk characterization that began with a screening level assessment, followed by a baseline assessment that incorporated a re-evaluation of potential impacts and other site assumptions.

Carefully Evaluate the Assumptions and Uncertainties Associated with Site Characterization Data and Site Models – The risk assessment for the Lower Fox River and Green Bay discussed uncertainty associated with the supporting site data, temporal and spatial variability, and toxicity and exposure assumptions made during development of the site models.

Select Site-Specific, Project-Specific, and Sediment-Specific Risk Management Approaches that Will Achieve Risk-Based Goals – The Lower Fox River and Green Bay FS report does not select a preferred remedy, instead a range of alternatives, action levels, costs, and relative risk reduction are presented.

Ensure that Sediment Cleanup Levels are Clearly Tied to Risk Management Goals – Endpoints will be compared to residual risk levels over time and achievement of the project RAOs.

Maximize the Effectiveness of Institutional Controls and Recognize Their Limitations – Due to elevated PCB levels at the Lower Fox River and Green Bay, WDNR issued consumption advisories for fish and waterfowl in 1977 and 1987, respectively, and Michigan issued fish consumption advisories for Green Bay in 1977.

Design Remedies to Minimize Short-Term Risks While Achieving Long-Term Protection – In evaluating potential remedies for the Lower Fox River and Green Bay, short-term risks will be minimized to the extent practicable.

Monitor During and After Sediment Remediation to Assess and Document Remedy Effectiveness – A Model Long-term Monitoring Plan was prepared as part of the FS to ensure that the selected remedy is adequately mitigating risk and achieving project RAOs.

References

EPA, 2002. *Principles for Managing Contaminated Sediment Risks at Hazardous Waste Sites*. OSWER Directive 9285.6-08. United States Environmental Protection Agency, Office of Solid Waste and Emergency Response. Drafted October 22, 2001. Signed February 12, 2002.

NRC, 2001. *A Risk Management Strategy for PCB-Contaminated Sediments*. National Research Council, National Academy of Sciences, Committee on Remediation of PCB-Contaminated Sediments. National academy Press, Washington, D.C.

1.4 ARARs and TBCs

Master Comment 1.9

Commenters stated that RAO 1 is inappropriate because the EPA and WDNR determined that state water quality criteria are not ARARs for sediment remediation.

Response

The Agencies disagree with this statement. RAOs are not required to mirror state and federal laws and guidance. If this were the case, then there would be no need for RAOs and environmental agencies would only need to consider ARARs and To be Considered (TBCs).

Master Comment 1.10

Many comments were received which, in part, challenged the viability of the Proposed Plan based on discharge water quality and quantity concerns. In particular, the comment authors claimed that the dredging recommended in the Proposed Plan was not viable because the quality and quantity of wastewater generated in the dredging process could not comply with water quality standards and associated WPDES permit limits, even using the most advanced wastewater treatment process. The wastewater quantity and quality limitations would, therefore, restrict the allowable wastewater discharge rate, thereby decreasing the allowable dredging rate and increasing the dredge schedule from the 7 years estimated in the Proposed Plan to as much as 37 to 60 years. Based on these assumptions, the comment authors concluded that in-place sediment capping was the only viable alternative for remediation of the Lower Fox River sediment.

Response

In response to these interpretations, WDNR analyzed the assumptions used to support the commenters' conclusions, and performed an evaluation to determine if the expected dredge process wastewater characteristics and volumes would restrict or limit the viability of the Proposed Plan as claimed in the comments. The complete evaluation can be found in *White Paper No. 7 – Lower Fox River Dredged Sediment Process Wastewater Quality and Quantity: Ability to Achieve Compliance with Water Quality Standards and Associated WPDES Permit Limits*. This analysis confirms that dredge process wastewater quantity and/or quality does not restrict the viability of dredging as recommended in the Proposed Plan and therefore does not solely justify capping. Several shortcomings of the commenter's original analysis were identified that lead to their conclusion including: failure to properly interpret and apply Wisconsin Statutes and Administrative Codes, failure to acknowledge the two permitted discharges from the pilot dredging projects at Deposit N and SMU 56/57, and failure to acknowledge that effluent data from the two dredging projects represents the most representative data for evaluating limitations.

Please also see response to Master Comments 5.52 through 5.60 below.

Master Comment 1.11

Commenters suggested that the proposed remedy will not comply with location-specific ARARs relating to wetlands, Endangered Species Act (ESA), and Fish and Wildlife Coordination Act.

Response

WDNR believes that it is in full compliance with the Clean Water Act (CWA), the ESA, and the Fish and Wildlife Coordination Act. WDNR will continue to abide by all applicable statutory requirements of these and other laws.

It is unclear as to which wetlands the commenters are referring to as being destroyed during the implementation of the remedy. However, although removal is proposed in shallow water, the RI/BLRA/FS clearly illustrates that the proposed remediation does not overlap with identified wetlands. Further wetland-related issues are addressed in *White Paper No. 8 – Habitat and Ecological Considerations as a Remedy Component for the Lower Fox River*.

Regarding the commenters' concern that: "The RI/FS & PRAP Violate The Fish and Wildlife Coordination Act" they failed to understand the significance of the statement in the Proposed Plan which reads: "Federal, state, and tribal officials subsequently signed an agreement on July 11, 1997, to share their resources in developing a comprehensive cleanup and restoration plan for the Lower Fox River and Green Bay." Indeed, WDNR and EPA are closely coordinating all activities associated with both the remedy selection and implementation as well as Natural Resource Damage Assessment (NRDA). This is clearly illustrated by both the consent decrees reached with Fort James Operating Company and Appleton Papers Inc./NCR Corporation for funding remediation and restoration activities.

1.5 Public Participation and Concerns

Master Comment 1.12

Commenters argued that WDNR and EPA could not issue a ROD based upon the RI/FS because citizens have not been able to comment on all documents because they're still not available for comment.

Response

"The community/public participation activities to support selection of the remedy were conducted in accordance with CERCLA § 117 and the NCP § 300.430(f)(3)." Complete copies of the RI/FS, Proposed Plan, and other related documents have been made available to the public. These have been available at five public repositories in the Fox River Valley as well as being posted on the WDNR's web page for the Lower Fox River (http://www.dnr.state.wi.us/org/water/wm/lowerfox/index.html). In addition, the administrative records for the RI/FS and Proposed Plan are available at the WDNR's offices in Green Bay and in Madison.

The information repositories are located at the Appleton Public Library, Oshkosh Public Library, Brown County Library in Green Bay, Door County Library in Sturgeon Bay, and Oneida Community Library. Five additional locations, at the Kaukauna, Little Chute, Neenah, De Pere, and Wrightstown Public Libraries, still maintain a fact sheet file, although they are no longer information repositories.

EPA awarded a $50,000 Technical Assistance Grant (TAG) to the CWAC in 1999 and another $50,000 grant was provided in 2001. The council has used its TAG to inform the community about the Lower Fox River investigations. To fulfill its obligations, CWAC developed a website, printed flyers and bumper stickers, paid for newspaper advertisements and paid technical advisors to review EPA- and WDNR-generated documents.

WDNR and EPA held numerous public meetings and availability sessions beginning in the summer of 1997 to explain how and why the Site was proposed for the Superfund NPL. In February 1999, a draft RI/FS was released with a 45-day public comment period, which was extended an additional 60 days. Prior to and after the release of the draft RI/FS, WDNR and EPA provided for extensive community and public participation, and kept residents, local government officials, environmental organizations, and other interest groups apprised of the steps of the process. Well-attended public meetings, small group discussions, meetings and presentations for local officials, and informal open houses continued through 2001.

Public meetings and Proposed Plan availability sessions were announced to the public at a press conference on October 5, 2001, and received extensive coverage through television, radio, and newspaper stories. The final RI/FS and Proposed Plan were formally presented at public meetings held on October 29, 2001 in Appleton and October 30, 2001 in Green Bay where oral and written comments were accepted. Additionally, WDNR and EPA mailed meeting reminders and Proposed Plan summaries to the 10,000 names on the Lower Fox River mailing list. Press releases pertaining to the Proposed Plan, comment period, and public meetings were sent to newspapers and television and radio stations throughout the Fox River Valley. Display advertisements announcing the Proposed Plan, comment period, and public meetings were also placed in Green Bay and Appleton newspapers. The presentations, question-and-answer sessions, and all public comments taken at the meetings were recorded and transcribed. The written transcripts of the public meetings are available in the information repositories, the administrative record, and on the WDNR Lower Fox River web page. Approximately 400 people attended.

More than 20 public meetings and availability sessions have been held regarding the project. Cleanup and restoration activities, the status of pilot projects, fish consumption advisories, and the February 1999 draft RI/FS released by WDNR have been among the topics on which these meetings focused. Additionally, over 15 small group and one-on-one interview sessions have been held. Project staff have also made more than 60 presentations to interested organizations and groups. In addition, WDNR, EPA and their intergovernmental partners publish a bimonthly newsletter, the *Fox River Current*, which is mailed to over 10,000 addressees. To date, 23 issues of the *Fox River Current* have been published.

Copies of the various supporting reports and the Proposed Plan were made available to the public during a public comment period that began on October 5, 2001 and concluded on January 22, 2002. Approximately 4,800 written comments were received via letter, fax, and e-mail. A copy of this RS for these comments is attached to the ROD. Newspaper advertisements were placed in the *Green Bay Press Gazette* and the *Appleton Post Crescent* announcing the availability of the Proposed Plan and its supporting documents, and a brief summary of the Proposed Plan in the information repositories. The Proposed Plan, the RI/FS, and other supporting documents containing information upon which the proposed alternative was based were also made available on the WDNR's website.

Master Comment 1.13

Commenters expressed the view that that the Agencies should consider alternative remediation goals for the Lower Fox River that are protective of human health and the environment. Concerns were raised that local governments were not presented with sufficient information to determine whether the cleanup goal set forth in the Draft FS is the appropriate cleanup goal for the River. They noted that cleanup standards less stringent than that set forth in the Draft FS have been adopted for other PCB sites.

Response

In response to comments received from the public, and from an independent peer review on the 1999 RI/FS, WDNR and EPA required that the FS consider a range of potentially applicable RALs and alternatives. The FS evaluated six RALs (0.125 to 5 ppm and no action) and up to six different options for each reach. Thus, 25 separate alternatives and the supporting information and evaluations were developed for each OU of the River.

The Proposed Plan considered the 1 ppm RAL based on risk, costs, and the CERCLA nine criteria (see response to Master Comment 4.13). Cleanup standards are site-specific; and both less stringent, and more stringent values have been adapted, based on site-specific considerations. These have ranged from as low as 0.25 ppm up to 5 ppm. The RAL of 1 ppm in the Proposed Plan was determined based upon careful consideration of protecting human health and the environment, and balancing that against the CERCLA nine criteria, that also considers cost and community acceptance. The cleanup goal was determined consistent with CERCLA as well as EPA policy and guidance, and consistent with the recent guidance issued by the NRC.

Master Comment 1.14

Commenters noted that the public participation process must be continued proactively throughout the entire remediation process and follow-up monitoring phase. They said the Agencies need to meet directly with the public in both communities along the River and Bay at least twice yearly during the project, and that active and open public involvement in the design and implementation of the cleanup is crucial to a successful cleanup.

Response

WDNR and EPA are committed to keeping the public informed. WDNR and EPA are issuing a fact sheet and will hold a meeting with the public to discuss the ROD for OUs 1 and 2. As is stated in the current community involvement plan, WDNR and EPA will meet with the public throughout the project's design, implementation, and monitoring phases.

Furthermore, once a ROD is signed, Superfund requires that community involvement plans be updated. Staff from the Agencies meet with the public to identify concerns and informational needs pertaining to the cleanup. That public involvement and communication plan is currently in preliminary development. WDNR and EPA expect the post-ROD community involvement plan may include regular general public meetings and more focused meetings to address community concerns regarding specific aspects of project activities. The regularity of those meetings will be determined as the plan is developed. Additionally, regular briefings of local governmental and tribal officials may be held.

WDNR and EPA staff will continue to be available to make presentations to interested local organizations and groups. These activities will enable WDNR and EPA to take municipal and community input into consideration during the design, implementation and monitoring phases.

Master Comment 1.15

Commenters recommended that a River and Bay PCB Remediation Advisory Committee should be created, as an oversight group with no veto power but with the power to force reconsideration and/or appeal upon a majority vote and public interest advocacy.

Response

Through an EPA program called Community Advisory Groups, citizens can meet regularly and stay involved in the cleanup's progress. While the group would not have power to force reconsideration of aspects of the cleanup, it could serve as a focal point for the exchange of information between the Agencies and the community. More information on this program can be found at http://www.epa.gov/superfund/tools/cag.

Master Comment 1.16

Commenters stated that local governments have a perspective independent from the paper mills, WDNR, and EPA, and wish to have their perspective understood by all other parties.

Response

The Agencies will continue to talk with local government officials to ensure that their perspective is understood throughout the cleanup process.

Master Comment 1.17

Commenters suggested that public involvement and accessibility should be improved by involving citizens from Door County and the western shore of Green Bay; producing simpler, consistent summaries of the RI/FS; and keeping the process accessible at every step.

Response

Several citizens were interviewed in 1998 and 1999 from these areas. Their input was included in the community involvement plan. They are also part of the 10,000 names on the mailing list for the *Fox River Current* bimonthly government newsletter. One of the Site's five information repositories is at the Door County Library in Sturgeon Bay.

Master Comment 1.18

Commenters stated that the public would see clear and significant economic benefits of Lower Fox River and Green Bay remediation. Some commenters stated that economic educational materials are necessary. Other commenters stated that the Agencies should articulate the economic benefits of thorough cleanup.

Response

The Agencies agree with these sentiments. It is the Agencies' belief that other sediment remediation projects have also seen economic improvements after completion of sediment cleanup. However, preparation of this type of analysis and educational material is beyond the scope of the RI/FS and ROD.

However, in support of the above, it should be noted that the Wisconsin statutes and the NCP both require that the selected remedy be protective of human health and the environment and the selected remedy fulfills this requirement.

In addition, it is the Agencies' belief that other sediment remediation projects have also seen economic improvements after completion of sediment cleanup. Though preparation of a specific economic analysis and educational material is beyond the scope of the RI/FS and ROD, WDNR and EPA are mindful of the economic consequences on the local economy of a large-scale, multi-year cleanup project in the Fox River Valley. Both Agencies have publicly stated that the selected remedy for the Lower Fox River should not be unnecessarily harmful to the local economy, and it is the Agencies' belief that the remedy selected in the ROD will fulfill this concept.

A project of the magnitude called for in the ROD will bring many jobs and paychecks to the Fox River Valley. While the Agencies have not specifically quantified the economic benefits, certainly many local suppliers of material needed for the remediation will see an increase in orders. To be sure, the remedy called for in the ROD is expensive, but these are dollars that will be spent in the Fox River Valley – on equipment, fuel, supplies, hotels, restaurants, etc. – all of which will have beneficial economic impacts on the Valley. At the conclusion of the cleanup work, a clear, but intangible benefit will be a cleaner River for all citizens of the Valley to enjoy. Increased tourism should result as the Fox River Valley becomes a more attractive destination and the world-class fishery of the River is rehabilitated. The Agencies have reviewed the financial health of the several companies likely to be most impacted financially by the ROD, and have concluded that they can undertake the financing for a project of this magnitude and not be unnecessarily harmed (see *White Paper No. 17 – Financial Assessment of the Fox River Group*).

Master Comment 1.19

Commenters were concerned that the proposed Lower Fox River cleanup plan would not protect human health and protect the local economy.

Response

See response to Master Comment 1.18 above and Sections 3 and 5 of this RS.

Master Comment 1.20

Commenters acknowledged that a PCB problem exists and some action is necessary. They then expressed the opinion that the PCB risk and exposure has been overstated and overly generalized. As a result, the Proposed Plan is technically flawed, overbroad, not cost-effective, and likely will not achieve the stated RAOs.

Response

WDNR and EPA disagree with this characterization. In developing the RI/FS, the BLRA, and Proposed Plan, WDNR followed EPA guidance in addition to working closely with EPA. The Agencies believe the remedy selected in the ROD is technically feasible, cost effective, and will achieve the site-specific RAOs.

Master Comment 1.21

Commenters stated that the extraordinary scope of the Proposed Plan remedy for Little Lake Butte des Morts makes the need for site-specific analysis critical.

Response

WDNR and EPA agree that site-specific analysis is very important. The recommendation in the Proposed Plan for Little Lake Butte des Morts is site-specific for that OU. We have based our decision on the information concerning the degree and extent of the contamination in the RI for Little Lake Butte des Morts, risks were assessed specific to Little Lake Butte des Morts, and technologies and costs were assessed specific to Little Lake Butte des Morts. Based on this individual assessment of the Little Lake Butte des Morts OU, WDNR and EPA selected the remedial option in the ROD.

Master Comment 1.22

Commenters expressed the need for following an adaptive management approach and recommended that planning should proceed in general accordance with the Proposed Plan guidelines, but with a commitment to apply the principles of adaptive management throughout the process and offered to be involved.

Response

The WDNR and EPA would like to see the continued efforts of the Green Bay RAPSTAC as well as other parties and inform of them of progress made as this project is undertaken. Furthermore, WDNR and EPA also want to be adaptive to the lessons learned as this remedy is implemented. The Superfund process has flexibility built into it. If, during implementation of an alternative, "lessons learned" indicate that the original decision should be modified, this can be readily done under the Superfund process. The administrative approach depends on the extent of the modifications. The potential modifications are as follows:

- **Minor Modification –** No specific documentation required;
- **Significant Modification –** Documented in an "Explanation of Significant Differences;" and
- **Fundamental Modification –** Documented in a "Record of Decision Amendment."

Any new information learned during implementation of dredging or other activities can be readily incorporated into this process, and appropriate adjustments made as needed.

Master Comment 1.23

Commenters suggested that the Agencies should implement the remedy as soon as possible with maximum public access and stringent government oversight.

Response

Comment noted. The Agencies will, as part of the community involvement plan, attempt to involve and inform the public of ongoing remediation activities as well as governmental oversight actions.

Master Comment 1.24

A commenter stated that appropriate metrics should be developed to change the remedy if remediation does not progress as expected and that action levels should be developed to be used during and following remedial activities to evaluate the effectiveness of remedial activities.

Response

WDNR and EPA agree that appropriate metrics need to be considered. Flexibility has been incorporated into the ROD. The ROD describes how the Agencies will decide whether cleanup objectives have been met. The process makes it clear that appropriate measurement techniques will be employed, while at the same time allowing for some flexibility in how these standards are measured and whether a protective cleanup standard is achieved.

2 Remedial Investigation

2.1 Sources of PCBs

Master Comment 2.1

Commenters stated that the Proposed Plan's PCB loading estimates significantly overstate the total PCB discharge to the Lower Fox River and that WDNR's assumptions result in an overestimation of discharges by the recycling mills.

Other commenters expressed concern that statements on past PCB use in the Fox River Valley as described in the Draft RI and Proposed Plan contain a series of statements about PCB quantities discharged into the River, about the time period during which discharges occurred; and about the parties responsible for these discharges that are unsubstantiated and inappropriate. These statements are based entirely on Draft *Technical Memorandum 2d (TM2d)*.

Response

PCB Load estimates in the RI/FS and the Proposed Plan are based on TM2d, *Compilation and Estimation of Historical Discharges of Total Suspended Solids and Polychlorinated Biphenyls from Lower Fox River*. This document acknowledges that the discharge of 313,600 kg of PCBs is an estimate. It acknowledges that number may be high, or it may be low. For the purpose that it was developed, for evaluating the performance of water quality models, it is believed that the estimate is "good enough." The estimate was developed based on work done cooperatively with the PRPs that have been identified for this Site. Multiple opportunities were afforded the PRPs to present facts, data, and comments during the preparation of TM2d. The 1999 revision is the "final" work on this technical memorandum due to the inability of the PRPs to reach consensus on an approach or data to be used, or for them to provide the WDNR an allocation of contribution of PCBs from the discharges. This WDNR approximation is based on a complete review of the data, as well as information presented to WDNR by the PRPs. Please refer to TM2d for more information on how these estimates were calculated.

Master Comment 2.2

A commenter expressed concern with the Proposed Plan statement that, "Approximately 313,600 kg (690,000 lbs) of PCBs were released to the environment" as a result of the manufacture and de-inking of PCB-containing NCR Paper. The best available information suggests that this estimate, taken from the Draft TM2d, is low due to a number of factors.

Response

As is stated in TM2d, the estimate of 313,600 kg number may be high, or it may be low. However, it is believed that this is an accurate estimate based on work done cooperatively with the PRPs identified for this Site. Multiple opportunities were afforded the PRPs to present facts, data, and comments during the preparation of TM2d. The 1999 revision is the “final” work on this technical memorandum and factors have been considered.

Master Comment 2.3

Commenters expressed concern with the Proposed Plan statements that “Ninety-eight percent of the total PCBs released into the Lower Fox River had been released by the end of 1971” and “Five facilities contributed over ninety-nine percent of the total PCBs discharged to the river.” The concern is that these estimates are inaccurate because they overlook the significant PCB discharges by the boxboard and de-inking mills between 1971 and 1980 due to the use of post-consumer papers containing carbonless copy paper through file clearing activities.

Response

The Agencies agree with the comments as they relate to the exact percentages of the PCB discharges to the system and modifications have been made to the ROD, as necessary. It should be noted that TM2d contains a disclaimer which specifically states that TM2d has not been developed for the purpose of allocating liability. Furthermore, the Agencies do not believe that it is necessary or appropriate to modify the estimates at this time. As is presented above, refinement of the 1999 estimates of discharge are being made by a consultant to the U.S. Departments of Interior and Justice for the purpose of allocation of liability. The PRPs and their consultants have been afforded multiple opportunities to respond to requests for information relating to PCB discharges to this system. However, even if these percentages are slightly off, WDNR and EPA believe that the assertion that the use of TM2d is a good estimate of PCBs discharged from point sources to the Lower Fox River.

Master Comment 2.4

A commenter expressed concern regarding the statement in the Proposed Plan that, “Approximately 70 percent of the total PCB quantity discharged into the river has migrated into Green Bay.” The commenter claimed that the statement is not accurate because it assumes that all discharged PCBs that are not currently in the River must be in Green Bay.

Response

Wording has been modified in the ROD, as necessary. The intent of this statement was to follow through on the finding of the Lake Michigan Mass

Balance Study that up to 70 percent of the PCBs ultimately entering Lake Michigan on an annual basis come from the Lower Fox River.

Master Comment 2.5

Commenters stated that recent sampling events in Little Lake Butte des Morts Deposit POG identified the presence of a large deposit of woodchips (16,000 cy) with PCB Aroclor 1254 contamination. The RI/FS does not identify this 1254 deposit and therefore has neglected the significant contribution of non-Aroclor 1242 PCBs.

Response

WDNR and EPA agree that PCB Aroclor 1254 is the primary Aroclor detected in the samples collected within the woodchip deposit. However, according to the sampling data provided for the woodchip sampling conducted in 2001, at least four of the nine samples appear to have Aroclor 1242 detections at concentrations ranging from 0.48 to 1.8 ppm. Aroclor 1242 was used in the manufacture of carbonless copy paper as identified in the 2001 Draft RI/FS.

Concerning the source of the 1254 Aroclor contamination, as is pointed out in TM2d, there are numerous sources of PCBs in the Lower Fox River. EPA and WDNR believe that TM2d accounts for most of the contributors of PCBs from paper manufacturing and recycling. Unfortunately, the woodchips and associated Aroclor 1254 were not discovered by any party investigating the River until recently. WDNR and EPA plan to move ahead with further sampling as part of the final remedy design.

Finally, it should be noted that the Aroclor mixture bears little relationship to the calculation of human health risk (i.e., to food chain exposures) in the Lower Fox River. While additional deposits should be considered in the final cleanup decision, 16,000 cy is a relatively small volume compared to the entire volume considered for remediation in OU 1.

Master Comment 2.6

Comments were offered that claim that over the last 11 years (1989–2001), water column PCB concentrations declined at a rate where concentration half-lives are 6.8 years at the De Pere dam and 9.0 years at the mouth. The authors also claim these rates are consistent with declines in PCB concentrations in fish tissue and sediment throughout the River in general.

Response

Similar points have been raised for Little Lake Butte des Morts and have been addressed in the response to Master Comment 2.16. The underlying issue is that the sampling and analysis methods in 1998 and 2000/2001 were sufficiently different from the previous efforts so that data comparability was not assured. Therefore, it is not possible to determine how much of the projected decline is due to changes in water concentrations versus how much might be due to very different sampling and analytical methods.

The sampling and analysis methods in 1998 and 2000/2001 were sufficiently different from the previous efforts so that data comparability was not assured. It is not possible to determine how much of the projected decline is due to changes in water concentrations versus how much might be due to different sampling and analytical methods.

Master Comment 2.7

A comment was provided which asserts that the characterization of the microcapsules used to make NCR Paper as being fragile is incorrect. The comment cites a report which characterizes the microcapsules as being "considered essentially stable under conditions typically encountered in the use of secondary fiber."

Response

The comment is noted, and if necessary, this editorial change will be made in subsequent documents. This term was not included in the ROD in the description on NCR paper.

Master Comment 2.8

The Proposed Plan states that the PCB-containing "emulsion was sold to Appleton Coated Papers who produced the coated paper in Appleton, Wisconsin." A significant percentage of the emulsion was sold and used elsewhere, particularly by Mead Corporation in Ohio.

Response

See response to Master Comment 2.1. Appropriate editorial modifications will be made in the ROD, as necessary.

2.2 Aroclor 1242 vs. 1254

Master Comment 2.9

Commenters offered that the recent sampling in Little Lake Butte des Morts proves that there is at least one other source of PCBs at the Site unrelated to the recycling of NCR paper. The authors offer that other sources of the recently found small deposit of woodchips containing primarily Aroclor 1254 and 1260 could be capacitors, transformers, hydraulic fluids, rubbers, adhesives, and wax.

Response

There is general agreement that PCB Aroclor 1254 is the primary Aroclor detected in the samples collected within the woodchip deposit in Little Lake Butte des Morts. However, according to the sampling data provided by CH2M HILL for the woodchip sampling conducted in 2001, the Aroclor used in carbonless paper, Aroclor 1242 is also detected. However, this information by itself does not conclusively suggest additional sources. The commenters must also recognize that three of the sources they identified, capacitors, transformers, and hydraulic fluid, are also basic components of their own papermaking equipment.

WDNR and EPA have never claimed that all of the PRPs have been identified. The Agencies will review and consider any additional information provided that assists in identification of additional responsible parties.

2.3 Time Trends Analysis

Master Comment 2.10

Commenters took issue with the comprehensive time trends analysis conducted for the RI. They argue that there are declines in PCB concentrations in fish tissue, sediments, and water that are not used or improperly applied in the RI/FS and Proposed Plan. Their analysis is based on two papers submitted: *BB&L Report on PCB Trends in Fish from the Lower Fox River* (the "BBL Report") and *Time Trends in PCB Concentrations in Sediment and Fish, Lower Fox River, Wisconsin* by Dr. Paul Switzer.

Response

As stated in *White Paper No. 1 – Time Trends Analysis* was collaborated upon by three eminent biostatisticians: Dr. Nayak Polissar (Ph.D. from Princeton University), Dr. Kevin Cain (Ph.D. from Harvard University), and Dr. Thomas Lumley (Ph.D. from University of Washington). All three have published extensively in human health toxicological and epidemiological studies, and are affiliated with the Department of Biostatistics at the University of Washington. Their curriculum vitae are set forth as an attachment to *White Paper No. 1 – Time Trends Analysis*. Specific comments to the methods employed in the TTA are covered in *White Paper No. 1 – Time Trends Analysis*.

Comments relating to alleged declines in water column concentrations of PCBs are discussed in Master Comment 2.16.

Master Comment 2.11

The commenters contend that PCB concentrations in fish tissue are continuing to show decline within the Lower Fox River. They dispute the statistical trends analysis conducted for the RI that showed a leveling off of fish tissue concentrations (the "breakpoint analysis"). They further argue that there is no apparent reason for the breakpoint, that the RI used an inappropriate statistical model, did not make the best use of the available data, and that a simple mathematical representation of the data shows a long-term, consistent downward trend.

Response

WDNR and EPA believe that fish tissue concentrations have not continued in a downward trend at the rate suggested by the commenters. Furthermore, the analysis conducted for the RI/FS suggests that in many cases, the rate of change has slowed to unacceptably slow levels, or in some cases stabilized and show no change at all.

The central dispute raised by these comments can be seen in the differing interpretation of changes in fish tissue concentrations in the two graphics below. Figure 1, from the Proposed Plan, shows that carp PCB tissue concentrations in OU 1 decline up to a point where a statistically significant "breakpoint" is observed, and that the change in the rate of decline from that point in time is essentially flat. As presented in the TTA, the breakpoint for that species in that reach of the River appears to occur around the mid-1980s. Figure 2 shows the direct-line comparison, using the same data, presented by the FRG's consultant, BBL, which suggests a steady state and continuing decline. This was also observed for several other species in OUs 1 and 4.

Figure 1 Carp PCB Tissue Concentrations in OU 1

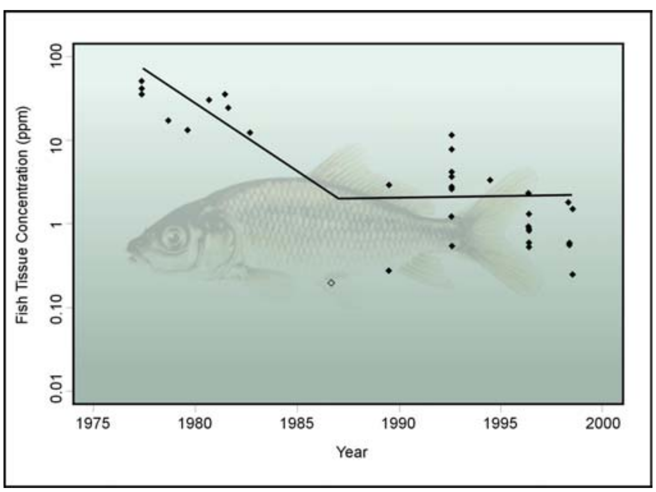
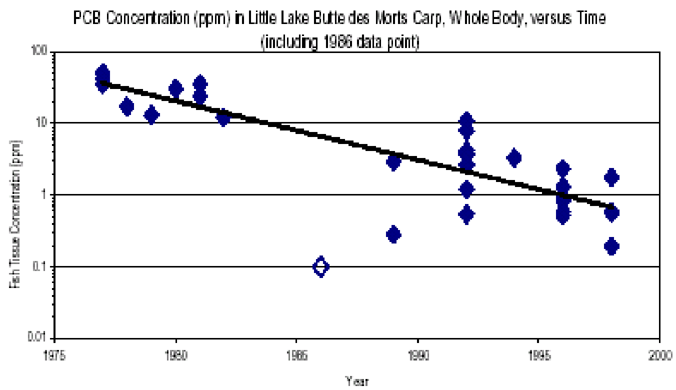


Figure 2 Carp PCB Tissue Concentrations in OU 1 Direct-Line Comparison



The TTA presented an analysis of trends in PCB concentrations for fish throughout the River and southern Green Bay. The analysis demonstrated that the rate of decline in fish tissue concentrations observed through the 1970s changed. Several important fish species, including carp, perch, and walleye, show statistically significant slowing of the decline rate, with a breakpoint occurring in the trend in the early to mid-1980s. Even where decline was noted, WDNR and EPA believe that the fish tissue concentrations will remain at concentrations above acceptable levels for some time to come.

As pointed out in the comment response above, the FRG retained Dr. Switzer to critique the work conducted on the TTA. While there are issues raised relating to the choice of model and use of data (discussed in more detail below and in *White Paper No. 1 – Time Trends Analysis*), the fundamental point raised in Dr. Switzer's review is that there is "no identifiable physical reason for a breakpoint and the time series are relatively short." Without being supplied other detailed documentation concerning the Lower Fox River, Dr. Switzer provides a thoughtful critique of the methodology, proposes alternate models and approaches that may be taken, but is not engaged to conduct any of the work proposed. The apparent approach taken in the FRG's comments was to have Dr. Switzer critique the statistical methods in the TTA, and then offer an alternative, simplistic model presented by the FRG's consultant, BBL.

When examining the main tenant of Dr. Switzer's critique, there is a readily identifiable physical reason for a breakpoint. The changes in fish tissue concentrations is observed to occur at that period of time when the mass of PCBs released by direct discharge by the paper mills falls below the steady-state releases of PCBs from sediments. In other words, fish tissue concentrations respond to the diminishing PCB inputs to the River by paper mill discharge, up until the point where the direct release is lower than the sediment release. At that point in time, fish tissue concentrations reflect exposure to sediment releases, and are subject to decline only at the rates at which sediment PCB concentrations decline.

TM2d: Compilation and Estimation of Historical Discharges of Total Suspended Solids and Polychlorinated Biphenyls from Lower Fox River Point Sources (WDNR, 1999) (TM2d) documents the direct discharges of PCBs from point sources between 1954 and 1997. Table 1 shows a compilation of data compiled in that document for OU 1, and a summary of all direct PCB discharges to the River. Within all reaches of the River, TM2d documents that while direct PCB discharges dropped off significantly in 1971, there were continuing discharges of PCBs up through 1997. While between 1971 and 1972 direct discharges dropped by one order of magnitude, there were continuing inputs at or exceeding 200 pounds annually from the paper mills. The 1989/1990 Mass Balance Study (WDNR, 1995) documented that direct measures of PCBs taken at the Appleton dam measured 143 pounds of PCB discharges in 1989, at a time when direct discharges were less than 2 pounds annually. Thus, a readily identifiable physical reason for a breakpoint in the fish tissue concentration would occur around 1978.

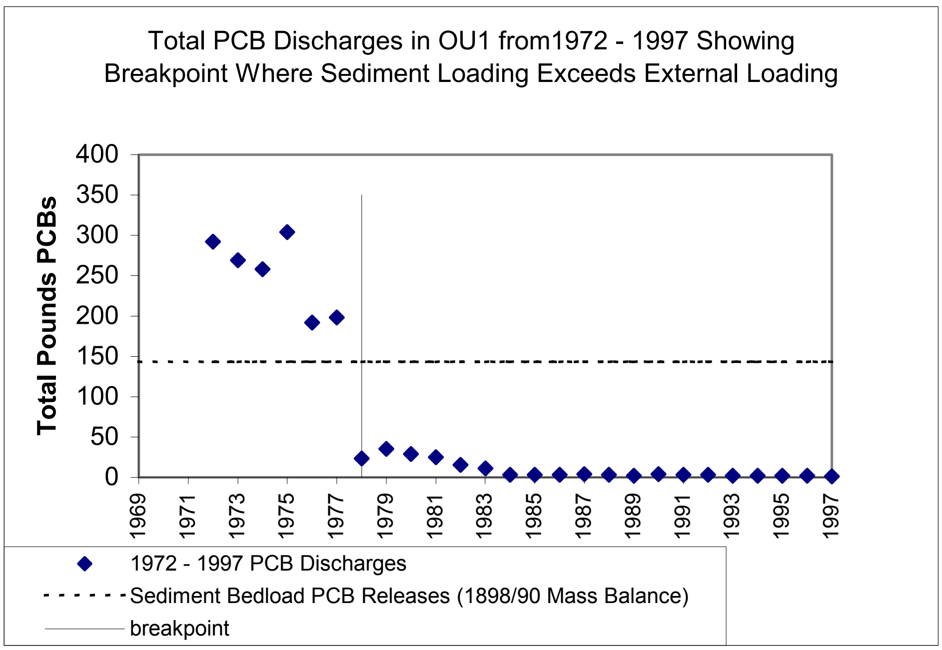
The relatively constant, or in some cases increasing trend observed, is related to source control of direct inputs of PCBs through wastewater discharges, with the continuing, constant source now being the PCBs in the sediments. A similar finding was observed on the Hudson River after the leakage of unweathered PCB oil from the vicinity of the GE Hudson Falls facility had largely been controlled (EPA, 2002).

Table 1 Total Discharges of PCBs in OU 1, 1954 through 1997 (Data adapted from *Technical Memorandum 2d*, Appendix D)

Year	Direct PCB Releases in OU 1			
	P.H. Glatfelter Discharge	P.H. Glatfelter Landfill	NM POTW/ Wisconsin Tissue	Total OU 1 PCB Discharges
1954	288	48	110	446
1955	1,268	190	542	2,000
1956	2,293	326	709	3,328
1957	2,264	390	938	3,592
1958	4,032	545	1,171	5,748
1959	4,868	730	1,982	7,580
1960	4,870	730	1,966	7,566
1961	7,246	1,087	2,096	10,429
1962	8,687	1,303	2,490	12,480
1963	10,767	1,615	2,419	14,801
1964	11,996	1,799	2,434	16,229
1965	12,635	1,895	5,641	20,171
1966	16,265	2,439	7,676	26,380
1967	14,502	2,175	5,820	22,497
1968	19,048	2,857	8,635	30,540
1969	22,650	3,397	11,297	37,344
1970	14,947	2,242	10,692	27,881
1971	2,875	431	1,750	5,056
1972	241	36	15	292
1973	234	35	0.1	269.1
1974	223	33	2	258
1975	263	39	2	304
1976	191	0	1	192
1977	198	0	0.3	198.3
1978	23	0	0.3	23.3
1979	35	0	0.2	35.2
1980	29	0	0.1	29.1
1981	25	0	0.1	25.1
1982	15	0	0.3	15.3
1983	11	0	0.1	11.1
1984	3	0	0.1	3.1
1985	3	0	0.1	3.1
1986	3	0	0.1	3.1
1987	4	0	0.1	4.1
1988	3	0	0	3
1989	2	0	0	2
1990	4	0	0	4
1991	3	0	0	3
1992	3	0	0	3
1993	2	0	0	2
1994	2	0	0	2
1995	2	0	0	2
1996	2	0	0	2
1997	1	0	0	1

Figure 3 represents this graphically for the period of 1972 to 1997 in OU 1. Prior to 1978, direct discharge releases still exceeded those PCB loads documented by the 1989/1990 Mass Balance Study, which is shown as the hatched line at 143 pounds annually. In fact, the exposure concentrations seen by fish in OU 1 prior to 1978 would have been a combination of both the direct and sediment PCBs. This trend is typical of the entire River, although the data in TM2d suggest that greater direct loads were still contributed into OU 4 into the mid-1980s.

Figure 3 Total PCB Discharges in OU 1 from 1972 to 1997



This above does not, however, necessarily imply that the break will occur exactly in 1978, and in fact, most of the breakpoints shown in the TTA come in the early to mid-1980s. The TTA acknowledges that the breakpoints are "best fit" models, and are not precise estimates of the year in which change occurs. In the case of the carp example shown above for OU 1, there are very few data points for concentrations between 1982 and 1986. Equally important in evaluating the breakpoint is the biology of the fish themselves; fish exposed in the late 1970s will continue to be present in later years. For example, the usual longevity of carp is 9 to 15 years (maximum observed is 47 years), while walleye average 7 years (Becker, 1983). Thus, carp exposed in 1971 when as much as 28,000 pounds of PCBs were discharged into the River would still be in the system in the mid-1980s.

The issues relating to selection of models, use of data, and responses to specific technical issues raised are detailed in *White Paper No. 1 – Time Trends Analysis*.

References

Becker, G. 1983. *Fishes of Wisconsin*. The University of Wisconsin Press. Madison, Wisconsin.

EPA, 2002. *Trends in PCB Concentrations in Fish in the Upper Hudson River, White Paper 312627, Responsiveness Summary: Hudson River PCBs Site Record of Decision, January 2002*. Prepared for the United States Environmental Protection Agency and the United States Army Corps of Engineers, Kansas City District by TAMS Consultants.

WDNR, 1995. *A Deterministic PCB Transport Model for the Lower Fox River between Lake Winnebago and De Pere, Wisconsin*. PUBL WR 389-95. Wisconsin Department of Natural Resources. Madison, Wisconsin.

WDNR, 1999. *Lower Fox River and Green Bay PCB Fate and Transport Model Evaluation Technical Memorandum 2d: Compilation and Estimation of Historical Discharges of Total Suspended Solids and Polychlorinated Biphenyls from Lower Fox River Point Sources*. Wisconsin Department of Natural Resources, Madison, Wisconsin. Revised February 23.

Master Comment 2.12

Commenters suggested that PCB concentrations are declining in surface sediments at a rate that supports a natural attenuation alternative within the River. The commenters praise the analysis taken in the TTA, stating that "…the analysis of surface sediment PCB trends by MWL [sic] gives a meaningful depiction of changing PCB concentrations in the active layer…" Concerns were raised that the Proposed Plan relies not on the analysis done in the TTA, but on the separate analysis done as part of the documentation for the Whole Lower Fox River Model.

Response

WDNR and EPA agree that surface sediment concentrations over time have slowly declined, on average. An important element of the TTA is that while the estimated annual compound percent increase in PCB levels calculated for each deposit show general decline, in many cases the upper bound of the 95 percent Confidence Interval show that concentrations could be increasing. In addition, the stability of PCBs that are currently buried in the sediment cannot be assured indefinitely. Sediment conditions in OUs 1 through 3 are a result of and dependent upon maintenance of the current dam and lock system indefinitely. Changes in lake levels are resulting in increasing scour to sediments in OU 4 (LTI, 2002). Lower Lake Michigan elevations are expected through this century as a result of changes to global climate (EPA, 2000). Thus, it is the position of both WDNR and EPA that the sediments of the Lower Fox River do not represent a secure location for the long-term storage of PCBs.

An excellent example of the need to consider all data are new data submitted with public response for OU 1. As documented in *White Paper No. 2 – Evaluation of New Little Lake Butte des Morts PCB Sediment Samples*, these data collected in 2001 and 2002 do not support the position taken by the companies that surface sediment concentrations are decreasing within OU 1. An analysis of those data clearly show that in some cases concentrations are lower, and in others higher. For example, within deposits A/B, C, and POG, higher sediment concentrations were measured than had ever been previously reported within the RI/FS. This is especially true in deposits A and POG, where six new stations exceeded 50 ppm, and one station in Deposit POG with a surface concentration of 360 ppm. Samples collected in Deposit E, on the other hand, suggest that the single high concentration of 45.9 ppm collected in 1994 may now be under 10 cm of newly deposited sediment. This combination of lower and higher observations suggest that in spite of best efforts on all parties, sampling variability may result in decreasing or increasing trends. Furthermore, the additional data submitted still show that concentrations in OU 1 exceed the RAL of 1 ppm, and thus constitute an unacceptable risk to human health and the environment.

References

EPA, 2000. *Preparing for a Changing Climate: The Potential Consequences of Climate Variability and Change, Great Lakes – A Summary by the Great Lakes Regional Assessment Group for the U.S. Global Change Research Program*. United States Environmental Protection Agency, Office of Research and Development, Global Research Program. October.

LTI, 2002. *Measurement of Burial Rates and Mixing Depths Using High Resolution Radioisotope Cores in the Lower Fox River.* In: *Comments of the Fox River Group on the Wisconsin Department of Natural Resources' Draft Remedial Investigation, Draft Feasibility Study, Baseline Human Health and Ecological Risk Assessment, and Proposed Remedial Action Plan. Appendix 10*. Prepared by Limno-Tech, Inc., Ann Arbor, Michigan.

2.4 Validity of Interpolated PCB Maps

Master Comment 2.13

Commenters suggest that WDNR's estimates of PCB mass and sediment volume are overestimates. The basis for this claim is that errors in the interpolation method led to high PCB values being interpolated at depth in non-detect areas, resulting in overall high bias. Thus, as a result, WDNR's PCB interpolations use physically unrealistic parameters for their inverse-distance-weighing (IDW) interpolation scheme. In support of this claim, the commenters suggest that WDNR failed to incorporate into the interpolation sediment core data that show PCB non-detect values at depth, making it possible for high PCB concentrations to be interpolated into areas where existing data show the concentrations to be at or below the detection limit. These errors lead to overestimation of the size of hot spot areas and exaggeration of PCB mass at depth.

Response

The comment identifies a technical oversight in the interpolations of PCB mass and contaminated sediment volume in the River reach occupied by SMUs 56 through 73 only. Department staff revisited these estimates, determined there is 17 percent difference (reduction) in PCB mass in the above-mentioned SMUs; 12 percent of the total PCB mass in the entire segment of OU 4 downstream of the Fort James turning basin. Because the surface areas of the SMUs in question are small compared to those upstream, the flux ratio of PCBs to the water column is small enough that these at-depth PCB volume differences will have minimal affect on the conclusion reached for OU 4.

2.5 Evaluation Based on New Little Lake Butte des Morts Data

Master Comment 2.14

Commenters presented data that they suggest negates the PCB interpolated bed maps presented in the RI/FS and the remedial actions for OU 1 in the Proposed Plan. New sediment data were submitted as part of the response period with submittals from both P.H. Glatfelter Company and WTM1. These data were the result of sampling events undertaken by Blasland, Bouck & Lee (BBL) on behalf of the P.H. Glatfelter Company, and by CH2M HILL for WTMI. They further argue that these new data show relatively "low" levels of PCBs, specifically within Deposit E, and that these data also demonstrate that natural attenuation is occurring within OU 1.

Response

WDNR and EPA believe that the supplemental data submitted for OU 1 in fact support the remedial action. The data provided during the comment period consisted as either hard copy in the companies' respective submittal, or as part of the FoxView database submitted with the FRG's response. None of the supporting quality assurance/quality control (QA/QC) information was submitted during the response period. However, WDNR requested full data packages after the public comment period from both submitters in order to evaluate the data for the final FS, this RS, and for the ROD. Nevertheless, the packages were assessed for QA/QC conformance with the rules established for the Lower Fox River RI/FS, documented in the *Data Management Summary Report: Fox River Remedial Investigation/Feasibility Study* appendix to the RI. The evaluation of the new OU 1 data may be found in the *Addendum to the Data Management Report* and in *White Paper No. 14 –*

wLFRM Development and Calibration for the Lower Fox River/Green Bay Remedial Investigation, Feasibility Study, and Proposed Remedial Action Plan.

A complete analysis of the new data relative to the bed maps and conclusions of the Draft RI/FS may be found in *White Paper No. 2 – Evaluation of New Little Lake Butte des Morts PCB Sediment Samples*. The QA/QC'd data were plotted over the RI PCB-interpolated bed maps for OU 1. Based on the evaluation, the following conclusions were evident:

- Within the surface sediments (0 to 10 cm), most of the area within Little Lake Butte des Morts exceeds the 1 ppm action level. This was, and remains true for the largest deposits A, B, POG, and E. The surface-weighted average concentration is not altered by these new data.

- Higher surface concentrations of total PCBs are reported for deposits A/B, C, and POG. Concentrations of PCBs exceeded 50 ppm in deposits A and POG, where the RI had placed those at between 10 and 50 ppm.

- The TSCA PCB threshold of 50 ppm is exceeded for several of the new stations collected at deposits A and POG. This includes one of the highest PCB concentrations ever measured in Little Lake Butte des Morts at Deposit POG of 385 ppm. At Deposit POG, TSCA material is found as deep as the 100- to 150-cm profile. This will impact the proposed remedy for these deposits in that TSCA handling and disposal requirements were not included in the FS for Deposit POG.

- The new data suggest that Deposit E surface sediments are relatively uniform in concentration, between 1 and 5 ppm. The bed maps within the RI show an area of total PCBs exceeding 10 ppm. The interpolation was based upon a single data point of approximately 46 ppm collected in 1994. A similar level was reported in the new data, but it now appears to be just below 10 cm. The supplemental data collected within that same area are all less than 5 ppm, but are all still greater than the RAL of 1 ppm.

- PCB concentrations exceeding the RAL for some deposits may be less, or more than estimated in the RI/FS. For example, PCB concentrations at Deposit A exceed the RAL through the 30-cm depth profile. Within the RI grid maps, PCB concentrations requiring remediation to a depth of cut of 100 cm were found; the supplemental data show PCB concentrations of less than 0.05 ppm. By contrast, PCBs exceeding the RAL are deeper than included in the RI/FS for deposits POG (150 cm) and E (100 cm).

The additional data submitted on behalf of P.H. Glatfelter Company and WTMI generally support the conclusion of the RI/FS and the Proposed Plan. Surface sediments within OU 1 exceed the RAL of 1 ppm. The Proposed Plan-defined remedial actions at deposits A/B, C, POG, and E; these data support that decision. These new data do suggest that the final remedial footprints, both the horizontal and vertical profile, may be refined in the final design. The horizontal footprint for deposits A/B, C, and POG could be drawn larger than the existing bed maps indicate, whereas Deposit E may in fact represent a smaller area than defined in the RI. Depth of removal may be refined as well; the data suggesting that a shallower cut may be needed at deposits A/B and C, but deeper at deposits POG and E.

These new data do not support the position taken by the companies that surface sediment concentrations are decreasing within Little Lake Butte des Morts. A closer look at those data, relative to the bed maps, suggests that in some cases concentrations are lower, and in others higher. For example, within deposits A/B, C, and POG, higher sediment concentrations were measured than had ever been previously reported within the RI/FS. This is especially true in deposits A and POG, where six new stations exceeded 50 ppm, and one station in Deposit POG with a surface concentration of 360 ppm. Samples collected in Deposit E, on the other hand, are lower than the single high concentration of about 46 ppm collected in 1994. This combination of lower and higher observations suggest that this is more an issue of sampling variability, and not decreasing or increasing trends.

Master Comment 2.15

Commenters stated that the stability of much of Little Lake Butte des Morts' sediment bed prevents the reach's sediments from posing significant risk to human or ecological receptors. The reach does not pose a significant risk to local or downstream human or ecological receptors arising from erosion-generated resuspension and transport.

Response

Regardless of the apparent overall depositional nature of OU 1, there are areas where surface sediment concentrations have not decreased over the study period (Deposit A and portions of Deposit POG). Even with a lack of significant scour events, sediments in these areas are still acting as a source for the transport of PCBs. The fact that this transport occurs means that this reach does indeed pose a risk to downstream human or ecological receptors. In addition, *White Paper No. 2 – Evaluation of New Little Lake Butte des Morts PCB Sediment Samples* contains a relevant discussion on this topic.

2.6 Scour and Hydrology

Master Comment 2.16

Several commenters suggested that PCB transport from the Little Lake Butte des Morts sediments is small and is approaching levels similar to those entering from Lake Winnebago. Commenters use this observation to suggest that Little Lake Butte des Morts sediments are no more of a contributor to PCB levels in the water column than Lake Winnebago, RAOs 1 and 4 can not be attained, and Little Lake Butte des Morts sediments are stable. The commenters support their claim of Little Lake Butte des Morts sediment bed stability with the inference that the 2000/2001 TSS data for Little Lake Butte des Morts show that PCB transport does not increase during high-flow events due to increased sediment scour and that *Technical Memorandum 5d* (TM5d) indicates this will continue, essentially forever.

Response

The premise for these claims is based on information presented on RI Figure 5-16 and in Table 5-20. However, the RI gives an inaccurate picture of the PCB transport into and out of Little Lake Butte des Morts. Modifications have been made to the final version of the RI to correct calculation errors and to add needed qualifiers to better clarify what is known regarding PCB transport out of Lake Winnebago. The Green Bay Mass Balance Study (GBMBS) (WDNR, 1995) clearly shows that, while loads from Lake Winnebago were too low to be accurately quantified with the sampling methods used, upper bounds calculations showed the loads were insignificant compared to the loads in the Lower Fox River at Appleton.

Data collected since the GBMBS collected by the FRG (BBL, 1999; LTI, 2002) do not have limits of detection (LODs) low enough to improve on the mass estimates from Lake Winnebago. Field equipment blanks from the FRG 1998 (BBL, 1999) sampling event are all non-detects with LODs ranging up to 200 nanograms per liter (ng/L). Similarly, all the samples collected in Little Lake Butte des Morts ranged only up to 34 ng/L, illustrating similar limitations with this set of data as the GBMBS (WDNR, 1995). The 2000/2001 data is less clear due to lower measured concentrations resulting from a combination of changes in the River and much cruder sampling and analysis techniques that had much higher LODs. In the 2000/2001 data, all samples from Neenah and Menasha were non-detects with LODs higher than the 1989/1990 field blanks so nothing was added to our knowledge about PCB loads from Lake Winnebago. The high LODs also cause significant uncertainties in the concentration measured at Appleton. When detected, however, the concentrations at Appleton were still a significant fraction of the concentrations seen at the De Pere dam (Tables 2-4 and 2-5 in LTI, 2002). The LTI 2002 report also failed to discuss how field equipment blanks were considered in their concentration data and loading calculations.

It is possible that water quality concentrations leaving Lake Winnebago exceed water quality criterion, but the available data is not sufficient to accurately determine if the criteria are exceeded or by how much. The 1989/1990 study measured values in the Neenah Channel were of the same magnitude of the field blanks so the actual concentrations coming from Lake Winnebago are not known. The GBMBS showed the upper bound on the average concentration was around 2 ng/L, but the value could be a lot less; the techniques were not clean enough to tell. No data collected since the GBMB has LODs low enough to improve on this estimate. Thus, the more recent sampling efforts by the FRG also cannot support the claim that loads from Lake Winnebago are a significant fraction of the loads seen at Appleton or that RAOs 1 and 4 cannot be achieved.

The lack of increased TSS at Appleton during events does not mean the PCBs in the Little Lake Butte des Morts sediment are isolated from the water column. There was significant transport of PCBs from the sediment to the water column during the 1989/1990 study and the rate varied largely as a function of time of year or water temperature. While PCB concentrations do not seem to increase during high flows, they do not decrease either. Therefore, more PCB mass must be coming from the sediment during high-flow periods to keep the concentrations relatively constant. The conclusion remains that Little Lake Butte des Morts sediment continues to be a significant source of PCBs, which contributes to the overall load in the system and the corresponding risk.

Regarding the commenters' assertion that TM5d supports their claim of a stable sediment bed in Little Lake Butte des Morts, WDNR and EPA disagree with points made in the body of the comment on the effectiveness of Deposit E as a sediment trap and the degree to which PCBs in the sediment are isolated from the water column in spite of the low resuspension from Deposit E. Deposit E is not an effective sediment trap in terms of its ability to accumulate a significant fraction of the solids in the River. A significant fraction of the solids in the Little Lake Butte des Morts water column is algae with very little settling occurring. The GBMBS (WDNR, 1995) shows about one-third of the PCB mass in the water column becomes dissolved and a part of the particulate portion partitions to algae and other slow-settling solids.

References

BBL, 1999. *Natural Attenuation Assessment of the Fox River*. Prepared for The Fox River Group by Blasland, Bouck & Lee. April.

LTI, 2002. Measurement of Burial Rates and Mixing Depths Using High Resolution Radioisotope Cores in the Lower Fox River. In: *Comments of the Fox River Group on the Wisconsin Department of Natural Resources' Draft Remedial Investigation, Draft Feasibility Study, Baseline Human Health and Ecological Risk Assessment, and Proposed Remedial Action Plan*. Appendix 10. Prepared by Limno-Tech, Inc., Ann Arbor, Michigan.

WDNR, 1995. *A Deterministic PCB Transport Model for the Lower Fox River between Lake Winnebago and De Pere, Wisconsin*. PUBL WR 389-95. Wisconsin Department of Natural Resources. Madison, Wisconsin.

Master Comment 2.17

Some commenters suggested the RI/FS is based upon confusing and contradictory information regarding the scouring and the transport of River sediments. They contend that the Proposed Plan and draft FS suggest that the entire Lower Fox River including Little Lake Butte des Morts is dynamic and that PCBs buried anywhere in the Lower Fox River can become uncovered and suspended. They offer that site-specific data indicate that Little Lake Butte des Morts' sediment bed is stable, not dynamic as suggested TM2g as it is an impoundment. They believe the additional analysis they provided show that many deposits are, in fact, not highly dynamic or erosional, and are areas where PCBs are buried and will not be eroded even in a 100-year storm event.

Response

The WDNR agrees that some statements in Sections 4.2, 5.2, and 5.3 of the Proposed Plan regarding suspension and scour of sediments throughout the River are probably too general and not as valid for Little Lake Butte des Morts as for the lower segments of the River. Section 5.3, for example, was written as an attempt to summarize the hydrodynamic characteristics of the Lower Fox River, with its principal point being that the sediments, in general, are dynamic and do not function in discrete layers. Discussion of the work of TM2g was included to add credence to the generalized statement that "scouring of the sediment bed plays a significant role in the quantity of sediment and contaminants transported through the river system." To avoid confusion, any similar use of this discussion in the ROD will clarify the locational specifics of the TM2g study.

Regarding the use of water column data to support the claim that the sediment bed of Little Lake Butte des Morts is stable and not dynamic: a lack of increase in TSS during high flows may indicate minimal erosion of the sediment bed, but is not direct evidence that PCBs in sediments are isolated from the water column, as exemplified by the 1989/1990 water column data. Because PCB concentrations are not decreasing during varied flows, PCB-laden sediment must be acting as a source during higher flow events in order for these concentrations to remain relatively constant.

Regardless of the apparent overall depositional nature of OU 1, there are areas where surface sediment concentrations have not decreased over the study period (Deposit A and portions of Deposit POG). Even with a lack of significant scour events, sediments in these areas are still acting as a source for the transport of PCBs. It is for this reason that the WDNR has put forth and still maintains the decision of dredging the top 100 cm of this material, thereby removing some 97 percent of the mass of PCBs from the environment.

The reader is referred to the response to Master Comment 2.16 for additional elaboration of these additional studies.

Master Comment 2.18

A commenter indicated there are four direct lines of evidence behind the depositional nature of the Lower Fox River including the need for dredging, TSS decrease as the River flows downstream, PCB concentration gradients in sediment cores, and radioisotope patterns in thin sections of sediment cores.

Response

WDNR and EPA do not disagree that some deposition takes place in the Lower Fox River. However, the hydrodynamics of the Lower Fox River are very complex. Monitoring of the River indicates that the River is both erosional and depositional over time. Monitoring results indicate that without continued point sources contributing PCBs to the system, the continued presence of PCBs in the surface sediment layers is the result of erosion, transport, and redeposition of PCB-contaminated sediment.

Master Comment 2.19

A commenter offered that the 1977 data are uncertain due to rudimentary methods of vessel positioning (e.g., right angle prism, tag lines). TM2g of the MDR shows transect comparisons were 90 feet off, so 14-foot elevation change is untrue.

Response

As discussed in earlier responses, the Proposed Plan claim of 14 feet of scour is not based on the interpretations of Transect 1A of TM2g, but rather on the interpretations of the FIELDS map documents.

The 14-foot elevation change came from an interpretation of EPA FIELDS' interpolated maps, (i.e., a comparison of 1999 interpolated sediment elevation values with 2000 interpolated sediment elevation values). The most significant comparisons of sediment elevation differences over time are not unique instances of gains or losses in elevation, but rather the spatial and dynamic nature of these differences.

As stated in TM2g, the 1990 transect for Figure 1A is an average of the two bounding range lines. The possible error associated with this averaging is clearly addressed in the "Uncertainty" section of the document. Even if the 1990 transect is ignored, the elevation changes between 1977 and 1993 are significant. Horizontal accuracy and its associated errors (also thoroughly discussed in that Technical Memorandum) become less important when sounding data throughout the entire De Pere turning basin are compared. The 18-foot contour, plotted on both charts, has increased in size in the northwest and southeast direction from 1977 to 1993. Elevation losses exceeding a meter are common within the perimeter of this contour. Conversely, elevation gains of almost 70 cm are found on the upstream perimeter of the basin. Even under consideration of the most extreme error margins, this data clearly shows the dynamic nature of the sediments within the area of Transect 1A over this 16-year period of comparison.

Master Comment 2.20

A commenter suggested that the RI/FS' analysis of transect data fails to adequately consider the standard, or expected, error in bathymetric measurements. The commenter stated that the RI/FS does not characterize and quantify error and determine if elevation changes are within expected error. Bathymetric surveys were conducted as three different accuracy levels. The RI/FS failed to adequately consider sources of error in highest accuracy surveys. Comparisons did not add together uncertainty inherent in each set of measurements.

Response

Rather than estimating a combined error based on unknown indices of procedural error (as the FRG has done), the WDNR designed a field test to better define the actual combined error (equipment + procedural) of the United States Army Corps of Engineers (USACE) Class I surveys. Data collected at the SMU 56/57 demonstration site in August 1999 shows the combined vertical accuracy achieved by the USACE Kewaunee Office to be on the order of ±4 cm for their mapping work at this site on the Lower Fox River. Water depths at the site ranged from 1 to 6 meters, and accuracy was the same in deep (greater than 5 meters) water as shallow. Because these errors are random and not systematic, the combined errors associated with comparing transects from different times are not, as the FRG claims, cumulative, but rather combine as the Root-Sum-of-Squares (RSS) of the individual errors. Thus, the vertical RSS errors for the Class I transect comparisons is ±5.6 cm. Even under consideration of the highest slopes encountered in the River channel (thoroughly discussed in TM2g), the accuracy is still well within the required shallow-water range of ±15 cm.

Assuming the ±21-cm confidence interval proposed by the FRG was legitimate, and these errors were, in fact, cumulative, then the error margins associated with the pre and post-dredge hydrographic surveys of the SMU 56/57 demonstration site would translate to ±14,450 cy of sediment (723 truckloads); or ±18 percent of the total 80,000 cy removed.

Master Comment 2.21

A commenter suggested that the RI/FS failed to consider adequately the expected error in its analysis of the EPA bathymetric data. Same-day duplicate bed elevation measurement error was 26 cm (95 percent confidence). The commenter did not think that the expected bed elevation changes are believable.

Response

See response to Master Comment 2.20. Also, this point is addressed in the FIELDS Team's *White Paper No. 3 – Fox River Bathymetric Survey Analysis* in the discussion on the use of before- and after-survey bar checks.

Master Comment 2.22

A commenter discussed the possibility of compounded error in bathymetric surveys, specific to USACE data. The author suggested that the RI/FS failed to adequately consider expected error in analysis of USACE data. ±21 cm is 95 percent confidence interval, results in no significant average bed elevation changes for several transects. New figures were constructed in Exhibit 9 to show expected changes that are within the expected error and those that are not.

Response

The FIELDS Team's *White Paper No. 3 – Fox River Bathymetric Survey Analysis* uses tables and maps to demonstrate the effects of assuming that a change of ±21 cm (±1.4 feet) is the expected error in the USACE bathymetric survey data. These tables and maps demonstrate that even if this overly conservative value is used, there are still areas of considerable change in sediment elevation.

Master Comment 2.23

A commenter suggested that due to a simple mistake, the FIELDS figures show the results of 5 years of dredging on the Lower Fox River, not sediment scour. They argue that the data we evaluated were actually surveys post-dredge rather than pre-dredge. Their figures include error, transects, and additional after-dredge and channel condition data.

Response

The FIELDS Team's *White Paper No. 3 – Fox River Bathymetric Survey Analysis* report explicitly distinguished pre- from post-dredge survey results (see Table 2). In order to distinguish sediment elevation changes caused by events other than dredging, the FIELDS report performed separate analyses of non-dredge areas. The results of these comparisons are provided in both the tables and maps in the report.

Master Comment 2.24

A commenter noted that PCBs at depth are due to dredging events, not scour or mixing.

Response

The Lower Fox River sediment is part of a dynamic system that warrants close monitoring and repeated dredging over time. Both the FIELDS maps and the LTI Review (LTI, 2002) show that both erosional and depositional factors are involved in the Lower Fox River sediment system. The remaining questions relate only to the magnitude of those changes. While the WDNR and EPA agree that due to dredging activities, the bathymetric surveys performed by the USACE cannot be used quantitatively to determine the true extent of sediment movement, they are an indication of a system that may warrant more detailed analysis.

The LTI Review states that “navigational dredging, not erosion, accounts for the largest areas of apparent bed elevation declines” (LTI Review, p. 1). This conclusion is correct. However, the FIELDS Team’s maps, and those in the LTI Review, show that sediment elevation changes occur in non-dredge areas, even if one accepts that the survey data are not accurate within ±1.4 feet. These elevation changes are both negative and positive proving that natural changes in sediment distribution do occur in the system, both erosive and depositional changes.

The FIELDS Team’s maps of sediment elevation changes over time only show that a change has occurred. The causation is a separate matter. No other implication as to dredging effectiveness or USACE decisions are addressed by an analysis of the change in the sediment elevation.

The LTI Review states that the FIELDS maps show limited sediment elevation changes in areas previously dredged. Such a finding is not unexpected as many dredge areas are likely to have small vertical sediment removal and, hence, River sediment dynamics will lead to deposition in these areas. The authors of the LTI Review report similar findings. They note in Section 3.1 that, “Recently dredged areas are prone to fill in more rapidly than other river reaches, and areas filling quickly are likely to be dredged often, creating a cycle of deposition – dredging – deposition” (p. 7). Nonetheless, the maps show that large areas of dredge zones do have significant decreases in sediment elevation. On a more basic level, the bathymetric surveys performed in the same areas over time simply show changes in data values. These changes do not definitively identify an area as depositional or scour.

However, as noted above, incorporation of more complete survey dates and dredge dates into these analyses will help shed light on this subject.

The dynamic nature of River sediments may cause some areas to be scoured although they may be in predominantly depositional areas. Hence, the USACE performs dredging to remove deposition (shoals) over large areas such as the Fort Howard Turning Basin (FHTB) even though some portions of these areas may have scour.

The LTI Review, using more recent USACE survey data found that "For all year-to-year survey comparisons, the fraction of the bed showing detectable increases in elevation exceeds the fraction showing detectable declines" (LTI Review, p. 9). The authors of the LTI Review have also concluded that the sediment in the Lower Fox River is dynamic in both eroding and depositing sediment from one area to another. That USACE dredging is necessary is proof that the River sediment is dynamic and that movement of sediments occurs. Although sources of this sediment cannot be definitively determined by a bathymetric survey, likely sources of the sediment are runoff (lateral sources), upstream sources, and siltation of existing River sediment. The important point is that, since sediment is being both eroded and deposited in the Lower Fox River system, reasonable care should be taken to avoid having contaminated sediments move into areas currently below the risk level and to avoid having surface sediments with low concentrations of contamination move to expose underlying sediments with higher concentration contamination. Even if net scour is significantly lower than net deposition the preferential movement of certain sediments could greatly increase the overall surface concentration of PCBs, and greatly increase the cost of remediating contaminated sediments as they spread.

References

Limno-Tech, Inc., (LTI), *Review of USEPA FIELDS Analysis of Bed Elevation Changes in the Lower Fox River.* January, 2002. Referred to in the document as "LTI Review."

EPA, 2002. FIELDS Team's *White Paper No. 3 – Fox River Bathymetric Survey Analysis*

2.7 Lower Fox River Dams

Master Comment 2.25

A commenter expressed concern that the statement in the Proposed Plan that dams could fail with the result being a massive dislocation of PCB deposits from the River is highly improbable, and that historical records allow the operators to predict and then moderate flows.

Response

As part of the response to comments, WDNR evaluated the dams on the Lower Fox River. These dams are all inspected on a regular basis, have to undergo re-licensing every 20 years by the Federal Energy Regulatory Commission (FERC), and there are no plans to remove any of the dams at this time. Furthermore, this inspection and licensing program should avoid any catastrophic dam failure. If a decision is made to remove a dam, the water behind the dam would need to be gradually lowered which could result in resuspension of sediment and PCBs. It is also important to note that the dams on the Lower Fox River were not constructed as flood control structures. See also *White Paper No. 4 – Dams in Wisconsin and on the Lower Fox River*.

Therefore, these evaluations consider not only dam failure, but the process for possible dam removal and benefits. If a remedy (e.g., capping) precludes dam removal, then costs and responsibility for maintenance and protection of dams in perpetuity must be considered.

2.8 Adequacy of Data Collected to Support the RI/BLRA/FS

Master Comment 2.26

A commenter stated that per the Proposed Plan, an average between 125 and 220 kg of PCBs are exported annually from the Lower Fox River to Green Bay, whereas water column samples collected from July 2000 to July 2001 (high and low tides) show annual export rate is 83 to 103 kg of PCBs.

Response

This statement is part of the opening summary of the WTMI Company's comments. The paragraph containing this comment begins "The agencies' conceptual representation of the PCB problem at the Lower Fox River/Green Bay site ("the Site") is factually inaccurate." This comment is listed as one of the four examples where "In key respects, the Proposed Remedial Action Plan ("PRAP") and supporting technical documents (collectively "the PRAP documents") overstate the PCB problem."

The loading estimate provided in this comment is interesting, but the 2000/2001 data uses sampling and analysis techniques without including comparability with historic data as one of the data quality objectives; and the 2000/2001 annual mass estimates are based on significantly fewer data points. It cannot be concluded that loading estimates in the RI/FS and Proposed Plan are factually inaccurate.

Master Comment 2.27

Commenters suggested that the Proposed Plan estimates 30,000 kg of PCBs in the Lower Fox River and 69,000 kg of PCBs in Green Bay are not accurate. The FRG estimates 29,000 kg of PCBs in the Lower Fox River and 18,000 kg in Green Bay. The FRG believes their estimates mean that today -30 years after PCB releases essentially stopped, PCBs are buried in significant portions of the River sediment, and are not at all being flushed to the Bay.

Response

The estimates of PCB mass in the Lower Fox River and Green Bay are generated from Technical Memoranda 2e and 2f, respectively, which are included in the MDR. The difference in mass estimates in the River is small between WDNR and the FRG. WDNR and EPA disagree with the FRG that all PCB mass in the River is buried. Numerous studies have identified the riverbed as being dynamic (e.g., TM2f) and the FIELDS Team's *White Paper No. 3 – Fox River Bathymetric Survey Analysis*) and water column samples continue to show exceedances in water quality standards for PCBs indicated that a source remains.

Master Comment 2.28

A commenter suggested that the statements on changes of PCB concentrations are based on insufficient data.

Response

The RI/FS and the TTA are based upon the comprehensive data sets assembled in the Fox River Database (FRDB), while more data is always preferred, WDNR and EPA believe that the over 500,000 records within FRDB are statistically robust upon which to base the properly qualified conclusions in the TTA.

The FRG included a copy of their database, FoxView, with their comments to the Proposed Plan. A comparative analysis of the FRDB and FoxView has been completed. The goal of the analysis was to determine what data, if any, existed in the FoxView database but not in the FRDB, and the importance of that data to the RI/FS. The analysis concluded that upon incorporating the data submitted during the comment period into the FRDB, there will be a less than 1 percent difference in the final comparative record counts. This indicates that with respect to the substantive, RI/FS supporting data, there is no effective difference between the FRDB and FoxView databases. The full analysis is presented in *White Paper No. 14 – wLFRM Development and Calibration for the Lower Fox River/Green Bay Remedial Investigation, Feasibility Study, and Proposed Remedial Action Plan.*

3 Risk Assessment

3.1 Baseline Human Health Risk Assessment

3.1.1 PCB Toxicity

Master Comment 3.1

Commenters stated that the BLRA overestimates the toxicity of PCBs to humans because of three conditions:

1) The WDNR BLRA relied on toxic values calculated from animal studies and ignored evidence from more than 20 human epidemiological studies;

2) The high-intake consumer threshold was added because WDNR estimated that many of the recreational angler exposure thresholds would be met within 30 years without implementation of an active remedy (see FS at 5-4); and

3) The risk assessment did not adequately differentiate risk from reach to reach.

Response

WDNR and EPA have concluded that the use of EPA-derived toxicity criteria is appropriate for the human health risk assessment. These values were developed according to standard methodologies and, therefore, present a relative measure of the potential for adverse effects. Both the cancer slope factor (CSF) and the reference dose (RfD) that were used in the BLRA were also used by EPA in the Hudson River Risk Assessment where PCBs were also the primary contaminant of concern (COC). In defense of these values, the EPA has prepared white papers on PCB Carcinogenicity and Non-Cancer Toxicity as part of the Hudson River Responsiveness Summary ROD and both of these white papers are attached to this Responsiveness Summary (EPA, 2002). These papers include reviews of new epidemiological and toxicological information, and this information is also summarized in the Hudson River Responsiveness Summary ROD – Master Comments 571 and 541 (EPA, 2002). Specifically, the EPA defended its use of the current RfD for Aroclor 1254 (2×10^{-5}) based on EPA guidelines for selecting preferred toxicity values that are used in risk assessment (EPA, 1989) and because, at the time that the RfD was developed, the information was both internally and externally peer-reviewed (EPA, 1993).

Comments received on the BLRA did not question the use of the CSF, but did question the use of the RfD. On behalf of the FRG, AMEC (2002) recommended that the RfD be 10 times higher (2×10^{-4}) based on the application of revised uncertainty factors associated with the extrapolation from effects in monkeys to effects in humans. This revision was based on an analysis of human data and a comparison of human data to monkey data. The human data came from two capacitor manufacturing plants in New York State where workers had been exposed to Aroclor 1254. The two uncertainty factors that they recommended reducing were related to the extrapolation of subchronic to chronic data, and for inter-individual sensitivity. Currently, the EPA is conducting a reassessment of the noncancer health effects of Aroclor 1254; however, this reassessment has not been completed and it is not appropriate to use a reference dose that has not been adopted by the EPA. Preliminary findings of the reassessment indicate that the use of animal-to-human uncertainty factors are appropriate, citing results of studies that support greater sensitivity in humans than monkeys.

Use of the lower, current EPA-published reference dose is also supported in the Agency for Toxic Substances and Disease Registry (ATSDR) (ATSDR, 2002) *Toxicological Profile for PCBs*. This document presents detailed information from several studies that illustrate increased weight-of-evidence of noncancer effects (such as developmental, reproductive, immunological, and neurobehavioral effects) of PCBs at very low doses, especially in children (including fetuses and nursing infants). Many of these studies are also summarized in *White Paper No. 12 – Hudson River Record of Decision PCB Carcinogenicity White Paper* and *White Paper No. 13 – Hudson River Record of Decision PCB Non-Cancer Health Effects White Paper* (EPA, 2002) and Appendix D of the Hudson River Risk Assessment.

Inclusion of the high-intake consumer receptor is appropriate as it represents an upper end of the population of exposed anglers. This does not overstate the toxicity of PCBs, as the comments suggest, it merely presents an upper-bound estimate of intake.

WDNR and EPA believe the BLRA adequately differentiates risk for each reach/zone of the exposure area. A total of six different fish ingestion scenarios were evaluated: reasonable maximum exposure (RME) recreational angler with upper-bound concentrations; RME recreational angler with average concentrations; central tendency exposure (CTE) recreational angler with average concentrations; RME high-intake fish consumer with upper-bound concentrations; RME high-intake fish consumer with average concentrations; and CTE high-intake fish consumer with average concentrations. In addition, exposure point concentrations were calculated separately for each reach of the Lower Fox River and zone of Green Bay. As previously stated, these various exposure scenarios present the range of PCB intakes, which is independent of PCB toxicity.

In addition, *White Paper No. 12 – Hudson River Record of Decision PCB Carcinogenicity White Paper* and *White Paper No. 13 – Hudson River Record* *of Decision PCB Non-Cancer Health Effects White Paper* contain relevant discussions on this topic.

References

AMEC, 2002. FRG's Alternative Human Health Risk Assessment of the Lower Fox River and Green Bay, Wisconsin.

ATSDR, 2002. *Toxicological Profile for Polychlorinated Biphenyls (PCBs)*. Agency for Toxic Substances and Disease Registry. November.

EPA, 1989. *Risk Assessment Guidance for Superfund (RAGS), Volume 1: Human Health Evaluation Manual (Part A)*. EPA/540/I-89/002. United States Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, D.C. December.

EPA, 1993. *Workshop Report on Developmental Neurotoxic Effects Associated with Exposure to PCBs*. EPA/630/R-92/004. United States Environmental Protection Agency, Risk No. Assessment Forum, Office of Research and Development, Washington, D.C. May.

EPA, 2002. *Responsiveness Summary: Hudson River PCBs Site Record of Decision*. United States Environmental Protection Agency, Region 2 and United States Army Corps of Engineers, Kansas City District. January.

Master Comment 3.2

Commenters contended that the Proposed Plan exaggerates the potential for noncancer hazards in cases where hazard indices exceed 1.0.

Response

Inclusion of the high-intake consumer receptor is appropriate as it represents an upper end of the population of exposed anglers. This does not overstate the toxicity of PCBs, as the comments suggest, it merely presents an upper-bound estimate of intake.

In addition, *White Paper No. 12 – Hudson River Record of Decision PCB Carcinogenicity White Paper* and *White Paper No. 13 – Hudson River Record of Decision PCB Non-Cancer Health Effects White Paper* contain relevant discussions on this topic.

3.1.2 Fish Consumption Rates (rate and species mix)

Master Comment 3.3

Commenters contended that WDNR human health BLRA exposure assumptions were unrealistic. These commenters specifically disagreed with the following:

1) The use of Michigan survey data (West et al., 1989, 1993) on fish consumption rates when Wisconsin data (WFOR survey) is available because they believe that fish consumption rates are exaggerated.

2) The averaging of sample results in OU 1, which included a high percentage of carp samples, even though the evidence indicates little if any carp is actually consumed from OU 1.

3) The assumption that people actually eat significant amounts of carp.

4) The omission of carp from background calculations.

5) Fish consumption goals and projections regarding the number of subsistence anglers are unrealistic. (WDNR projected that up to 13,600 individuals ignore the advisories and consume fish at "high intake" rates. Commenters suggest that a survey of 7,026 licensed anglers in Wisconsin indicates that the 13,600 figure is overstated by at least a factor of 10).

6) A differential evaluation of potential risks to native American anglers who may consume fish from the assessment area because currently available data are inadequate to permit this analysis.

7) The analysis of low-income anglers as a sensitive subpopulation because there is no basis for this analysis.

8) The omission of age- and region-specific data on human mobility which resulted in the overestimation of exposure and risk.

One commenter suggested that the FRG Baseline Human Health Risk Assessment (AMEC, 2002) contains more realistic exposure conditions that result in substantially lower estimates of risks and hazards.

Response

WDNR and EPA have determined that the exposure and intake assumptions used in the BLRA are appropriately conservative, relevant to the Site, and are consistent with standard and customary EPA approaches. Each of the individual comments are responded to in sequence below.

A comparison of the risk estimates based on the Wisconsin survey data (AMEC's Human Health Risk Assessment) and similar information from the studies used in the BLRA indicates that consumption rates and risk estimates are not significantly different. The table below summarizes the risk estimates predicted by AMEC (2002) and those derived from the focused risk assessment when comparable data are used (e.g., perch data from 1990s only; De Pere to Green Bay Reach; reasonable maximum exposure [RME] scenario). Note that both evaluations used the same toxicity criteria for PCBs and the same carcinogenic averaging time; however, the noncancer averaging time used by AMEC is 15 years, while the BLRA noncancer averaging time for the RME scenario is 50 years.

Receptor	WDNR	AMEC	WDNR	AMEC	WDNR	AMEC	WDNR	AMEC
	Basis of Fish Ingestion Rates		Annualized Ingestion Rate (g/day)		Mean Cancer Risk		Mean Noncancer Hazard (HI)	
Recreational Angler	avg. of West et al., 1989 and 1993 studies	WFOR Study by TER, 1999	59 (Table 5-80)	61 (Table 4-3)	5.7×10^{-4} (Table 5-82)	1.1×10^{-4} (Table 4-1)	21 (Table 5-84)	9 (Table 4-1)
	Fiore et al., 1989 study		37 (Table 5-80)		3.6×10^{-4} (Table 5-82)		13 (Table 5-84)	
High-intake Fish Consumer	Hutchison and Kraft, 1994 study	Based on an evaluation of 6 studies: Hutchison and Kraft, 1994; Hutchison, 1994; Hutchison, 1999; WDHSS, 1998; WFORS (TER, 1999); Steenport et al., 2000	81 (Table 5-81)	90 (Table 3-27)	7.9×10^{-4} (Table 5-86)	3.9×10^{-4} (Table 4-2)	30 (Table 5-88)	36 (Table 4-2)

Table Notes:
HI – Hazard Index
Assumptions of fish species consumed:
WDNR – These data presented reflect that it was assumed that only perch (white and yellow) were consumed by both recreational anglers and high-intake fish consumers.
AMEC – Recreational angler species preferences were based on the WFOR Study and included 95.5 percent yellow perch, 1.5 percent walleye, 1 percent white perch, and 2 percent other. High-intake fish consumer species preferences were based on Hutchinson (1998) and included 48.5 percent white perch, 16.7 percent white bass, 24.2 percent catfish, 7.6 percent walleye, and 3 percent sheepshead.

Furthermore, the studies that were used in the BLRA are appropriate and relevant for several reasons. The studies include West et al. (1989, 1993), Fiore et al. (1989), Hutchinson and Kraft (1994), Peterson et al. (1994), and Hutchinson (1999). Information from each of these studies was considered and incorporated in the derivation of risk estimates, and it was determined that upper-bound risk estimates were similar. Tables 5-82 through 5-89 provide these results for the focused evaluation, and for any given receptor-River reach-fish species subgroup evaluated; the results based on each exposure study are within a close range (within the same order of magnitude). As an example, the cancer risks for the RME recreational angler in the De Pere to Green Bay Reach using all fish species data from the 1990s (refer to Table 5-82) range from 4.6×10^{-4} to 9.7×10^{-4}. It is also important to note that the focused evaluation considered different species of sport fish individually, as well as combined species. This approach was deemed necessary to evaluate and be fully protective of recreational sport anglers that actively fish for certain species (e.g., walleye).

The exposure estimates selected for use in the BLRA were carefully selected based on literature as well as communication with various Agency personnel. The use of the two West et al. (1989, 1993) studies for exposure estimates is further supported by the fact that these are regionally relevant data and these studies were specifically discussed in detail in the EPA *Human Health Exposure Factors Handbook* (EPA, 1997). These data were also used to derive fish consumption rates for the Great Lakes Water Quality Criteria. Furthermore, use of the WFOR study as the basis of fish consumption rates may not be appropriate. Ingestion rates that are derived from a study conducted in an area where fish consumption advisories are in place are not representative of baseline conditions, which the goal of the BLRA.

People do eat carp and this is easily demonstrated by the number of web sites dedicated to finding and preparing carp for human consumption. Examples of these web sites include: www.carpanglersgroup.org, www.carp.net, www.carpuniverse.com, and www.carpdreamfishing.com. In addition, even if the subpopulation of carp consumers is small in comparison to subpopulations that consume other types of sport fish, the BLRA should be appropriately conservative to protect all populations of fish consumers.

As noted in the response to Master Comment 3.4, only a very limited amount of data was available for skin-on fillet samples from Lake Winnebago (the background location) in the 1990s. While it is true that no carp samples were available from this specific data set, the background information is merely presented for comparison purposes. The average PCB concentration for Lake Winnebago fish can also be compared to the average concentrations presented for white bass and walleye from the Site (these two species comprised six of the seven background samples), and this comparison also shows that concentrations in the reaches and zones are elevated above background.

The number of "high intake consumers" estimated in the risk assessment is said to be overstated. This number does not affect the resulting calculated risks for a high-intake consumer. Although there may not be adequate data to evaluate specific subpopulations (e.g., low-income, native American, etc.), this was not an objective of the risk assessment. The objective was to estimate risks to a high-intake consumer, regardless of the number of people that fall under this category or what other subpopulation they may be grouped into.

Information on human mobility was considered in the selection of the appropriate exposure duration (ED) for the angler. Appendix B1 of the BLRA presented detailed calculations of the time the potentially exposed population of anglers are expected to catch fish in the Lower Fox River and Green Bay.

The fundamental assumption used in this analysis is that the number of years the angler fishes is equal to the number of years the angler lives in the Lower Fox River and Green Bay region. The calculation presented in the BLRA recognizes that different anglers will spend different times in the area and, therefore, generate a probability distribution for ED. This probability distribution depends on the age of a receptor when that individual moves into the region, and the percent of times a move is within the region (as opposed to moving out of the region). Depending on the assumptions made for these two parameters, the mean of the probability distribution of ED ranges between 18 years and 33 years. The 95 percent value ranges between 25 and 75 years. ED values of 30 years for the CTE scenario and 50 years for the RME scenario were established based on professional judgment prior to developing the probabilistic analysis described in Appendix B1. These CTE and RME values are, however, consistent with the probability distributions, so these values are retained as the CTE and RME values for this analysis.

One of the main differences in the exposure estimates between the AMEC and human health portion of the BLRA is that the AMEC Human Health Risk Assessment assumed that fish tissue concentrations were declining and the WDNR BLRA assumed that fish tissue concentrations were static. This difference results from the fact that different data were used in the exposure analysis. WDNR performed an extensive time trends analysis (RI Appendix B), which indicated that fish tissue concentrations were not consistently declining for species that are routinely consumed by humans. In the absence of statistical confirmation that tissue concentrations were declining, exposure concentrations were assumed to be static. An assumption of declining fish concentrations would have to be well supported by the data in order to be certain that human health was being adequately protected. Additionally, even if fish concentrations were found to be declining over time, people have potentially been exposed to historically higher concentrations in fish for the past 30 years. Given the uncertainty in whether fish tissue concentrations were declining and the uncertainty associated with how long people may have been exposed to historically high PCB concentrations, WDNR used a static point estimate for fish tissue exposure concentrations.

References

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Fiore, B. J., H. A. Anderson, L. P. Hanrahan, L. J. Olson, and W. C. Sonzogni, 1989. Sport fish consumption and body burden levels of chlorinated hydrocarbons: A study of Wisconsin anglers. *Archives of Environmental Health*. 44(2):82–8.

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Hutchison, R. and C. E. Kraft, 1994. Hmong fishing activity and fish consumption. *Journal of Great Lakes Research*. 20(2):471–478.

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West, P. C., J. M. Fly, R. Marans, F. Larkin, and D. Rosenblatt, 1993. *1991–1992 Michigan Sport Anglers Fish Consumption Study*. Technical Report No. 6. Prepared for Michigan Department of Natural Resources, Ann Arbor, Michigan by University of Michigan, School of Natural Resources. University of Michigan. May.

Master Comment 3.4

Commenters stated that that cancer risk from eating fish caught at the Site is 20 times greater than from eating fish at Lake Winnebago (background) and that this is an overstatement because Lake Winnebago calculations excludes carp and the Site calculation includes carp.

Response

WDNR and EPA contend that exposure point concentrations for PCBs in fish are appropriately conservative for the BLRA. Comments indicate that carp tissue samples were resulting in an unrealistic representation of amount of PCBs in fish that are consumed, especially when comparing with background. There are populations of anglers that do consume carp (refer to websites listed in the response to Master Comment 3.3), and these populations must be considered in the risk assessment. The samples available for carp were included in the statistical calculations with the same weighting as all other fish species. In the majority of reaches and zones, carp comprise only a small percentage of species that were sampled (refer to Tables 5-76 and 5-78 of the BLRA); therefore, concentrations in carp do not necessarily result in unrealistically high PCB concentrations overall.

Regarding the lack of carp data included in the background calculations, only a very limited amount of data was available for skin-on fillet samples from Lake Winnebago in the 1990s (seven samples to be exact). While it is true that no carp samples were available from this specific data set, the background information is merely presented for comparison purposes. The average PCB concentration for Lake Winnebago fish can also be compared to the average concentrations presented for white bass and walleye from the Site (these two species comprised six of the seven background samples), and this comparison also shows that concentrations in the reaches and zones are elevated above background.

It would be extremely difficult to determine the percentage of each fish species that people are likely to consume on a reach- and zone-specific basis, and then area-weight the PCB concentrations for those species to arrive at a representative PCB concentration. While carp consumption may be overestimated, it is our opinion that the calculations are appropriately conservative to protect all populations of fish consumers.

Note also, the WDNR evaluation assumes that concentrations of PCBs in fish are constant over time. An assumption of declining fish concentrations would have to be well supported by the data in order to be certain that human health was being adequately protected. An extensive time trends analysis was performed that indicated that fish tissue concentrations were not consistently declining for species that are routinely consumed by humans. In the absence of statistical confirmation that tissue concentrations were declining, exposure concentrations were assumed to be static. Furthermore, even if it were possible to accurately predict future PCB concentrations in fish, there is substantial uncertainty in such projections. First, historical trends may not be accurate predictors of future trends. The fact that some time trends fit a double exponential function where the concentrations declined at a faster rate in the early 1980s than in the late 1990s suggests that future declines could be at an even slower rate. Second, the historical data are typically available for a period of 15 to 25 years, whereas the exposure periods of interest are 30 to 50 years. Thus, using historical data to predict future concentrations requires the additional assumption that the historical data will accurately reflect future concentrations over future time periods that are two to three times longer than the historical time period. The use of historical data from a 25-year period to predict concentrations over the next 5 years will give far more reliable results than the use of this same historical data to predict concentrations over the next 50 years. Finally, use of static concentrations provides an extra measure of conservatism should future disturbance of sediments (via flooding, ice scour, etc.) occur. Given the uncertainty in whether fish tissue concentrations were declining and the uncertainty associated with how long people may have been exposed to historically high PCB concentrations, WDNR used a static point estimate for fish tissue exposure concentrations.

Master Comment 3.5

A commenter questioned if there really was any risk from eating the fish, and stated individuals must decide for themselves what is an appropriate risk level.

Response

WDNR and EPA followed appropriate guidance in assessing risk, and stand by the risks identified in the BLRA for humans. See also response to Master Comment 3.3.

In addition, *White Paper No. 12 – Hudson River Record of Decision PCB Carcinogenicity White Paper* and *White Paper No. 13 – Hudson River Record of Decision PCB Non-Cancer Health Effects White Paper* contain relevant discussions on this topic.

Master Comment 3.6

Commenters expressed their opinion that no remedy would be sufficient to enable the removal of advisories for high-intake fish consumers.

Response

WDNR and EPA believe this remedy will meet the RAO of removing consumption advisories. Active remediation will accelerate the reduction in fish tissue concentrations of PCBs to background levels. The Agencies will continue to plan to use existing protocol to determine the need for fish consumption advisories.

Master Comment 3.7

Commenters expressed concern that the key to risk reduction at this Site is to reduce the PCB concentrations in fish that are consumed by human or ecological receptors. Other exposure pathways are not of significant concern.

Response

The BLRA did not conclude that eating fish was the sole route for PCB and mercury exposure and risk. Other pathways (e.g., waterfowl consumption) were also found to be of concern. The risk assessment did, however, conclude that the greatest exposure and risk are directly tied to fish consumption. WDNR and EPA believe that reducing risks from eating fish will result in reduced risks from all pathways.

3.1.3 Probabilistic Analysis

Master Comment 3.8

Commenters stated that a probabilistic risk assessment is far more appropriate than a point estimate analysis for risk management decisions at large sites.

Response

WDNR and EPA have concluded that the range of evaluations presented in the BLRA is appropriate for purposes of risk management decisions. The BLRA includes a wide range of calculated results for the two most sensitive receptors, the recreational angler and the high-intake fish consumer. Two RME scenarios have been assessed, one using upper-bound concentrations and the second using average concentrations, and a CTE scenario was assessed. Furthermore, the focused evaluation of PCBs from fish ingestion explored a wide range of exposure scenarios incorporating various intake assumptions and PCB concentrations. As part of the focused evaluation, a probabilistic risk assessment of exposure assumptions for the recreational angler and high-intake fish consumer was conducted and was summarized in the BLRA Section 5.9.6 and detailed in Appendix B1. The probabilistic evaluation analyzed the influence of variability by developing probability distributions for exposure parameters listed below:

- Fish concentration (three distributions were used):
  - Concentrations developed by Exponent (2000),
  - Concentrations from all fish species in Little Lake Butte des Morts Reach, and
  - Concentrations from all fish species in De Pere to Green Bay Reach;

- Fish ingestion rate and exposure frequency (for both recreational anglers and high-intake fish consumers based on the studies below):
  - Recreational angler:
    - West et al. (1989),
    - West et al. (1993),
    - Average of West et al. (1989 and 1993), and
    - Fiore et al., 1989;

- High-intake fish consumer:
  - Low-income minority (West et al., 1993),
  - Native American (Peterson et al., 1994 and Fiore et al., 1989),
  - Hmong (Hutchinson and Kraft, 1994), and
  - Hmong/Laotian (Hutchison, 1999);

- Reduction factor;
- Exposure duration; and
- Body weight.

A comparison of the results of the point estimate evaluations and probabilistic evaluations indicates that for similar sets of intake and data assumptions, the results of the point estimate evaluations are comparable to the 95th percentile results of the probabilistic evaluation. The table below presents the range of cancer risks (using the various studies for ingestion rates) for a recreational angler and high-intake fish consumer using concentrations for all fish species from the De Pere to Green Bay Reach.

Receptor	Focused Point Estimate Risk Range	95th Percentile Probabilistic Risk Range
Recreational Angler	4.6×10^{-4} to 9.7×10^{-4} (Table 5-82)	4.2×10^{-4} to 8.5×10^{-4} (Table 5-97)
High-intake Fish Consumer	4.0×10^{-4} to 1.4×10^{-3} (Table 5-86)	2.4×10^{-4} to 1.4×10^{-3} (Table 5-98)

The results above show that the RME point estimates of cancer risk are comparable to the 95th percentiles of the probability distributions of cancer risk. These results are consistent with the EPA (1999) interpretation of the RME scenario as a plausible high-end representation for the exposed population and protective of human health. As a result, WDNR and EPA conclude that the range of evaluations presented in this assessment sufficiently illustrates potential risks for average to high-end receptors. Importantly, EPA guidance specifies that point estimates of risk be used as the principal basis for decisions regarding the need for remedial action at a site (p. 5-120).

References

Exponent, 2000. *Baseline Human Health Risk Assessment of PCBs in the Lower Fox River System*. Prepared for the Fox River Group and Wisconsin Department of Natural Resources. Landover, Maryland.

Fiore, B. J., H. A. Anderson, L. P. Hanrahan, L. J. Olson, and W. C. Sonzogni, 1989. Sport fish consumption and body burden levels of chlorinated hydrocarbons: A study of Wisconsin anglers. *Archives of Environmental Health*. 44(2):82–8.

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3.2 Baseline Ecological Risk Assessment

3.2.1 Ecological Toxicity of PCBs

Master Comment 3.9

Commenters stated that the amount of PCBs in the eggs of a female fish is most likely determined by the relative lipid content (egg versus whole body), which varies considerably among species. It will be very different for salmon and lake trout (which tend to have lower relative lipid content in their eggs compared to other species; see e.g., Niimi and Oliver, 1983). This method introduces uncertainty into the toxicity reference value (TRV) derivation.

Response

In the BLRA, the PCB TRVs selected for fish were not lipid content-specific because the assessment endpoints of benthic and pelagic fish included fish of varying lipid contents. Therefore, the influence of lipid content on PCB bioaccumulation was not factored into the estimation of toxicity. The toxicity estimation was based on the total body content of PCBs. Lipid content in fish was, however, considered during the calculation of SQTs using bioaccumulation modeling.

References

Niimi, J. and B. G. Oliver, 1983. Biological half-lives of polychlorinated biphenyl (PCB) congeners in whole fish and muscle of rainbow trout. *Canadian Journal of Aquatic Sciences*. 40:1388–1394.

Master Comment 3.10

Commenters contend that the discussion of sediment appears to totally ignore the organic carbon content.

Response

These data were not ignored and sediment organic carbon concentrations were factored into the sediment quality thresholds that were derived. Sediment PCB concentrations were not, however, normalized to organic carbon concentrations because the sediment PCB threshold effect level for invertebrates was not dependent on organic carbon content.

3.2.2 PCB Congeners

Master Comment 3.11

WDNR received several comments regarding PCB analytical data used in the risk evaluation. While WDNR used both total PCB data and PCB congener data in the BLRA, a commenter contended that only PCB congener data should have been evaluated and that because total PCB data were evaluated, the BLRA significantly overestimates current and future ecological risks presented by the Lower Fox River and Green Bay.

Other commenters did not understand why PCB congener data were presented in terms of individual congener concentrations instead of toxic equivalency (TEQ) concentrations. Regarding the nomenclature used for dioxin and furan congeners, a commenter believed that the terminology should be more consistent.

Response

Both total PCB toxicity and congener-specific toxicity were evaluated in the BLRA. WDNR and EPA believe that both evaluations were necessary and consistent with risk assessment guidance, and with the recommendations of the NRC.

The PCB TRVs were derived from an exhaustive search of the scientific literature available at the time. Many of the studies found in the search were determined to be lacking one or more pieces of information that precluded their use in the BLRA. The remaining studies (i.e., those that were judged, based on sound science and professional experience to be credible) were used to derive the TRVs in consultation with the BTAG assembled for the ecological risk assessment in the BLRA.

In a literal sense, only 2,3,7,8-TCDD and 2,3,7,8-TCDF were carried forward as chemicals of potential concern (COPCs) as noted in the letter from Bruce Baker (attached as Appendix A to the BLRA). However, to be comprehensive, in the toxicological evaluation it was necessary to not only evaluate 2,3,7,8-TCDD and 2,3,7,8-TCDF, but all dioxin and furan structurally related compounds that are known to cause Ah-R-mediated toxicity to fish and wildlife. Minor revisions were made to the BLRA text to clarify this point. The dioxin and furan congener toxicity risk analysis was limited to those congeners that were analyzed in tissues and those congeners for which there were toxic equivalency factors (TEFs). The presentation of individual dioxin, furan, and PCB congener concentrations in the WDNR BLRA ecological exposure assessment instead of the total TEQ concentration was intended to transparently detail which congeners most significantly were responsible for the calculated exposure. TEQ exposure concentrations are presented in the risk characterization section of the BLRA.

In the fall of 2001, the World Health Organization (WHO) held a conference in Berlin, Germany to discuss risk assessment of non-dioxin-like PCBs (WHO, 2001). The toxicity of PCB congeners that bind to the Ah-receptor and are known to cause dioxin-like effects and this toxicity is evaluated though the application of TEFs. It is unclear, however, if this quantification of the toxicity of PCB congeners adequately characterizes the potential for risk from all PCB congeners. The TEF system of toxicity quantification does not directly apply to non-dioxin-like congeners because non-dioxin-like congeners do not have a common mechanism of action (WHO, 2001). It is important to better understand the potential for toxicity caused by non-dioxin-like congeners because the concentrations of these congeners in environmental media are much higher than the concentrations of dioxin-like congeners and, therefore, toxicity may be largely underestimated.

The Berlin conference in 2001 (WHO, 2001) identified approaches for the evaluation of non-dioxin-like PCB congeners. Resulting from this conference, the following non-dioxin-like PCB congener endpoints were identified: intracellular Ca^{2+} mobilization, Protein Kinase C (PKC) translocation, binding to the ryanodine receptor, induction of CYP2B/3A, estrogenicity, tumor promotion, immutoxic effects, neurotoxic effects (chemical, structural, functional), and other endocrine-related effects (insulin, thyroid hormone). It was noted that these endpoints may also be affected by dioxin-like PCB congeners. It is challenging to determine which effects are the result of dioxin-like congeners only, given exposure to a chemical mixture. In addition to recommending the toxicity evaluation of these endpoints, this conference panel recommended that a survey be conducted of the available exposure data with respect to the ratio of non-dioxin-like PCBs and dioxin-like PCBs, and non-dioxin-like PCBs and TEQs, respectively (WHO, 2001). It is clear from this conference that the WHO is concerned with the toxicity of all PCB congeners (209 total) and not just the 20 PCB congeners that are planar and exhibit dioxin-like toxicity. In the absence of clearly defined investigation methods for non-coplanar PCB toxicity, only analysis of total PCB toxicity can be used to characterize the risk from all PCB congeners.

Non-coplanar PCB congener toxicity is known to be potentially important and has been demonstrated at least in mammals (EPA, 2001; Giesy et al., 2000). There is not enough information in the scientific literature to evaluate the toxicity of non-coplanar congeners. The only way WDNR could be inclusive in the risk evaluation for the potential of non-coplanar toxicity was through the evaluation of total PCB toxicity. The evaluation of total PCBs is likely a conservative evaluation of the potential for non-coplanar PCB toxicity and in the absence of definitive information, the EPA requires that risk assessments err on the side of being adequately conservative. Non-coplanar PCB toxicity may be very species specific and may especially vary across phyla (e.g., fish, birds, and mammals). Even if it were possible to rigorously evaluate non-coplanar PCB toxicity would only have provided another line of evidence and even without an additional line of evidence toxicity was indicated. Therefore, knowledge of potential non-coplanar toxicity would only add to this argument that there is the potential for toxicity. In the review of both WDNR and FRG ecological risk assessments the Association for Environmental Health and Sciences (AEHS) made the following comment: "While much of the toxicity associated with PCBs may be related to Ah-R interactions, this association does not apply to several toxic effects (e.g., estrogenicity neurotoxicity). Thus, the use of both approaches is appropriate." (AEHS, 2000, p. 33).

Recently, the U.S. Navy prepared an ecological risk assessment issue paper comparing the advantages and disadvantages of risk analysis with PCB congeners as compared to total PCBs. A conclusion was that although PCB congener analysis does have advantages over Aroclor analysis including increased chemical specificity and detection limits, a primary disadvantage of the risk analysis of PCB congeners is that most of the PCB effects data in the literature is based on total PCB concentrations (Bernhard and Petron, 2001). This conclusion is supported by the scientific literature that was reviewed and included in the WDNR BLRA.

References

AEHS, 2000. *Peer Review Panel Report for the Fox River Human and Ecological Risk Assessments*. Prepared for the Fox River Group by The Association for Environmental Health and Sciences, Amherst, Massachusetts. June 28.

Bernhard, T. and S. Petron, 2001. *Analysis of PCB Congeners vs. Aroclors in Ecological Risk Assessment*. United States Navy Ecological Risk Assessment Issue Paper. Website: http://web.ead.anl.gov/ecorisk/issue/.

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WHO, 2001. *WHO Consultation on Risk Assessment of Non-dioxin-like PCBs*. Federal Institute for Health Protection of Consumers and Veterinary Medicine (BgVV), Berlin, Germany, September 3–4, 2001.

3.2.3 Screening Level vs. Baseline Risk Assessment

Master Comment 3.12

Commenters stated that ecological risks have been significantly overstated in the WDNR's BLRA largely because they contend that the WDNR ecological portion of the BLRA primarily focused on screening level risk rather than baseline risk. This same comment was also received from an earlier review of the draft BLRA conducted in 2000 by AEHS, an independent review panel (AEHS, 2000). As an alternative, some commenters challenged that the ecological risk assessment conducted by the FRG (BBL, 2002) is superior because it evaluates risks beyond the screening level analysis, is a more accurate evaluation of ecological risks, and was conducted in accordance with applicable guidance documents. The ecological risk assessment produced by the FRG supported a finding of no or low ecological risk from PCB exposure.

Response

WDNR and EPA disagree that the BLRA ignores EPA guidance. On the contrary, the risk assessments are consistent with guidance. The ecological risk assessment in the BLRA, specifically, was prepared with the assistance of the site-specific BTAG and EPA's national expert on ecological risk assessment. One of the charges of the BTAG and the national expert was to ensure that the BLRA followed EPA guidance. Whenever inconsistencies were noted, they were corrected so that the final document was in fact in accordance with EPA guidance.

A screening level ecological risk assessment provides a comparison of abiotic media concentrations to ecotoxicological benchmarks. Screening level ecological risk assessments do not include extensive site-specific information. The BLRA produced by WDNR included extensive site-specific information with regard to the nature and extent of the contamination, receptor-specific exposure factors, and species-specific information that was preferentially used in developing TRVs. Both NOAELs and LOAELs were used to put bounds on the risk estimates. Exposure concentrations were derived for not only abiotic media, but also for wildlife receptors and two exposure thresholds were calculated and used to bound the risk analysis; the mean and the 95 percent UCL of the mean. Wildlife receptor exposure estimates were determined from site-specific data as available and from exposure modeling using well-researched exposure assumptions. Not only did these exposure data standardize risk comparisons between regions, but modeled exposure data could be compared to actual Site data in some regions to determine the relative agreement between these two exposure estimation techniques. The selection of adverse effect levels was determined from the review of numerous articles from primary scientific literature. Additionally, the discussion surrounding the selection of these TRVs was standardized to make the selection process transparent. Regarding the risk characterization and summary process, the WDNR BLRA described risk interpretation, extensively summarized risks by area and by media, and included a summary of field study results.

A separate response to AEHS comments that were submitted in June 2000 has been prepared. As discussed in this response, the concerns of the AEHS panel were largely addressed in the Draft BLRA that was released in February 2000.

References

AEHS, 2000. *Peer Review Panel Report for the Fox River Human and Ecological Risk Assessments*. Association for the Environmental Health and Sciences, Amherst, Massachusetts.

BBL, 2002. Baseline Ecological Risk Assessment of the Lower Fox River and Green Bay, Wisconsin. Blasland, Bouck and Lee. January.

3.2.4 Habitat and Population Studies

Master Comment 3.13

Commenters contended that, currently, PCBs are not a cause of many use impairments or suspected impairments of Lower Fox River and Green Bay system. The PCBs in the system do not cause: (1) degraded fish or wildlife populations, (2) tainting of fish or wildlife flavors, (3) fish tumors or other deformities, (4) eutrophication or undesirable algae, (5) drinking water consumption or taste or odor problems, (6) beach closings, (7) degradation of aesthetics, and (8) loss of fish and wildlife habitat. In fact, the causes of these impairments include nutrient loadings, suspended solids, stormwater runoff, turbidity, and land development.

Response

WDNR and EPA did not claim that PCBs are the source of all the impairments identified for the Lower Fox River and Green Bay in the

Proposed Plan. However, WDNR and EPA do believe that PCBs are the major contaminant contributing to consumption advisories – and unacceptable health risk to those who do not follow the advisories – PCBs are suspected to be an impairment for degraded fish and wildlife and fish health-related alterations, degradation of benthos as well as populations of phytoplankton and zooplankton, restrictions on dredging activities, and additional costs to industry. WDNR and EPA also believe that significant reduction in PCBs in the River will go a long way to addressing other River impairments to use of the Fox River and Green Bay and once the PCB problem is addressed, it will make even greater sense to address remaining issues.

Master Comment 3.14

Commenters stated that the BLRA does not place sufficient reliance on the conclusions of USFWS reports.

Response

The WDNR participated in extensive discussions with the Biological Technical Assistance Group (BTAG), which included the USFWS and other trustees. The BTAG discussed published USFWS determinations and underlying studies and data, at length. Furthermore, the USFWS and other trustees commented extensively on proposals, language, and drafts that led to the RI/FS and Proposed Plan. In some cases, WDNR, in consultation with the EPA, adopted USFWS and other trustee comments. In fact, the WDNR requested and used USFWS and other trustee analyses and language in parts of the RI/FS. Significant USFWS and other trustee comments that were adopted by WDNR and EPA include: (1) incorporation of Green Bay into the RI/FS; (2) inclusion of ecological risk endpoints other than population endpoints; (3) incorporation of assessment data, analyses, and determinations into the RI/FS; and (4) incorporation of PCB fate and transport model documentation into the RI/FS.

On July 11, 1997, WDNR and EPA joined the other trustees to form the Intergovernmental Partnership (IGP), through a Memorandum of Agreement (MOA). The MOA was designed, in part, to coordinate response and restoration activities undertaken by the IGP. The response Agencies have clearly devoted considerable effort to coordinate with the USFWS and other trustees. However, the responsibility to weigh the merits of trustee determinations, comments, and positions for use in response actions belongs to WDNR and EPA. WDNR and EPA believe that they have considered trustee and other comments and that they have adopted those comments that merit inclusion.

The USWFS NRDA reports were designed to answer questions of injury, but not risk, they focused on individual species, and for some species the results are largely inconclusive. Importantly, the Agencies did consider and discuss all of the USFWS NRDA evaluations and used these studies in the BLRA to the extent that they were applicable to the evaluation of risk to assessment endpoints.

The BLRA discussed at length not only the USFWS NRDA studies, but also other field studies that had already been conducted on the Lower Fox River and Green Bay. In fact, these studies were presented as part of an integrated tool for risk managers to make informed decisions regarding ecological risk in the River and/or Bay. Specifically, Section 6.5.4 of the risk characterization section of the BLRA presents detailed summaries of the field studies involving water column invertebrates, benthic invertebrates, benthic fish, piscivorous fish, insectivorous birds, piscivorous birds, omnivorous birds, and piscivorous mammals. Studies on tree swallows by Custer et al. (1998) were used as a line of evidence in evaluating risks to the insectivorous bird assessment endpoint in Little Lake Butte des Morts and in Green Bay zones 1 and 2

References

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Master Comment 3.15

Commenters stated that benthic fish, pelagic fish, passerine birds, terns, and double-crested cormorants are not subject to population-level baseline risks associated with PCB exposure in the Lower Fox River and Green Bay.

Response

There appears to be some confusion between assessment endpoints and representative receptor species. This comment tends to focus on individual species such as terns and cormorants, when in fact, the BLRA used these species to represent all piscivorous birds, which could use the Lower Fox River system. It is important to recognize the distinction between the assessment endpoint and the measurement endpoint to avoid confusion between presence or absence of one species, with risk to the entire assessment endpoint. For example, terns and cormorants were species evaluated to represent the piscivorous bird assessment endpoint. To that end, adverse impacts to these species are meant to be representative of all piscivorous birds. Other species of piscivorous birds may be present (e.g., gulls, heron, egrets, etc.) that were not specifically evaluated, but must be protected. Therefore, it is imperative to be conservative, yet scientifically sound, when translating impacts on a given species to the assessment endpoint. That is, lack of impact on one receptor species does not mean the assessment endpoint is not at risk.

Additionally, the comment refers to population level baseline risks, when there is no discussion of this in the assessment endpoint that was evaluated (e.g., piscivorous bird reproduction and survival). The assessment endpoint focused on protecting reproductive rates and survival of birds, not necessarily all bird populations.

At the start of the risk assessment process for the Lower Fox River and Green Bay, there was discussion of initiating studies to address issues of risk directly on field populations of wildlife that use the Site. However, these types of studies generally require many years of data to be able to discern adverse effects due to contamination, and to differentiate the contaminant effects from adverse effects due to something else (e.g., food sources, predation, competition, immigration, emigration, weather, etc.). As such, a collective management decision was made to utilize the already existing data to evaluate and characterize risk.

Population measurement endpoints are appropriate when the data are collected to answer risk questions. Population data were included in the BLRA but were ultimately not used as lines of evidence for risk conclusions because causal evidence for increases or decreases in populations were not investigated. While these studies provide good information, they do not provide a definitive answer relative to the risk posed by the COPCs at the Lower Fox River Site.

While contaminant conditions may exist that would jeopardize the health of an assessment endpoint, the absence or presence of a given receptor species does not, by itself, indicate risk or no risk due to contamination. Likewise, the apparent increase of some populations (e.g., walleye and cormorants) is not inherently inconsistent with a conclusion of contaminant risk being present to piscivorous fish or piscivorous birds. The River and the Bay have been recovering from years of free dumping of waste products during the early to middle part of the 1900s. Years ago, the River had such a high biological oxygen demand that virtually no fish species were present. The rebounding of fish and wildlife populations because of better habitat (e.g., higher oxygen levels) and fewer contaminants does not indicate that there is no potential for adverse responses to Site contaminants. An increase in wildlife using the area implicitly increases the potential for exposure to contaminants to occur.

Master Comment 3.16

Commenters stated that that site-specific habitat and exposure data for risk quantification were ignored and that this goes against EPA risk assessment guidance which states “risks to organisms in field situations are best estimated from studies at the site of interest” (EPA, 1998). Comments indicated that many site-specific data contained within the FRDB (including data collected by the FRG, the USFWS, EPA, WDNR, universities, and other organizations and institutions) were not used as part of the risk investigation. One comment specifically addressed the fact that tern habitat is limited to the mouth of the River and Renard Island, and that the USFWS NRDA study showed no current risk to Caspian terns.

Response

The BLRA did in fact use site-specific habitat data. For example, insectivorous birds were not evaluated in two reaches of the River and three zones of the Bay due to habitat constraints. Additionally, alewife and smelt were evaluated in zones 1 and 2 but not in the River due to the habitats being appropriate in one location and not in the other. Lake trout were evaluated in the Bay and not in the River because that is where they are found. It would be inappropriate to consider lake trout in the River due to its habitat requirements. Further, Section 6.5.4 of the BLRA extensively discusses the field studies performed on the Fox River for water column and benthic invertebrates; benthic and piscivorous fish; insectivorous, piscivorous and omnivorous birds; and piscivorous mammals.

The question of whether the Lower Fox River contains, or the extent to which it contains, high quality habitat for the measurement endpoint receptor species (e.g., mink and terns), while important in making management decisions, is not strictly a contaminant risk issue. In addition, the argument that there is low habitat quality and thereby low risk has logic flaws because organisms that do use the area are still potentially at risk. If viable habitat exists or may exist, the organisms that use the habitat will be exposed to the contaminants. Given the goals of the NRDA, there is no way to forecast what sort of land use may occur in the future that may provide better habitat, potentially increasing the number of organisms exposed.

The data that were extracted from the FRDB and used for risk analysis were limited by receptor, by date of collection, and by data quality constraints. A full description of the data (type and quality) contained in the FRDB and used in the risk analysis is contained in Section 4 of the BLRA. In addition to the numerous Site data that were analyzed, the BLRA used information collected from recent scientific literature in the risk analysis.

There are several additional articles related to PCB toxicity in bald eagles, mink, and other mammals that have not been included in the risk evaluation either because the conclusions of these articles were considered to not influence the risk conclusions determined in the risk analysis or because these articles were published after the WDNR had conducted its literature review. WDNR and EPA do know that adverse effects from PCBs can occur in other mammals besides mink, thereby indicating that mink habitat is not specifically of concern, but whether there is habitat that may be used by any mammals. An additional article related to the toxicity of PCBs in bald eagles is Kaiser et al., 1980. Additional articles related to the toxicity of PCBs in mink include: Leonards et al., 1995; Halbrook et al., 1999; Hochstein et al., 1998; Backlin et al., 1998; Shipp et al., 1998; and Brunstrom et al., 2001. Articles related to the toxicity of PCBs in other mammals (i.e., otters, polecats) include: Behnisch et al., 1997; Leonards et al., 1994; Bergman et al., 1994; Davis, 1992; Elliott et al., 1999; Harding et al., 1996; Harding et al., 1999; and Hugla et al., 1998.

References

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3.2.5 Weight of Evidence Approach

Master Comment 3.17

WDNR received comments that the BLRA significantly overestimates current and future ecological risks presented by the Lower Fox River and Green Bay because the BLRA does not use the full weight of evidence in quantifying risks for decision making.

Response

WDNR acknowledges that numerical weighting of lines of evidence is a type of evaluation that was not used, but this is not the only weight-of-evidence approach. Few if any Superfund sites have not used this quantitative weight-of-evidence approach proposed by Menzie et al. (1996) in their risk characterization. However, although a numeric evaluation is intended to be more quantitative and explicit in the methods of risk ranking, the rationale for the determination of weighting factors assigned to each measurement endpoint was not clearly described or defended by BBL. Additionally, some of the weighting factors described in the text were incorrectly recorded in the tables used to summarize numerical scores.

Reference

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3.3 Peer Review Process and Response

Master Comment 3.18

Commenters stated that WDNR's HHRA and the BLRA appear to have responded to few, if any, of the AEHS peer review panel's recommendations.

Summary of Human Health Comments

At the request and funding by the FRG, the AEHS conducted a peer review (dated June 29, 2000) on both the Pre-Draft BLRA and the FRG human health assessment (Exponent, 2000). Four general "critical findings" were made regarding the human health assessments:

1) Significant differences between the WDNR and FRG results undermine confidence in input assumptions and procedures.

2) Neither risk assessment addressed the significant potential for prenatal or perinatal effects (e.g., effects to the fetus or nursing infant). There

is also the need to evaluate neurological/developmental effects from short-term, high-level exposure.

3) FRG conducted a stochastic approach while WDNR employed point estimates. The comment did not indicate one method being superior to the other; however, the stochastic techniques were not adequately described and in some cases not appropriate.

4) The FRG assumed much lower fish ingestion rates and lower PCB concentrations than the WDNR.

More specific comments (many related to the comments above) included the following:

1) "The problem with the RETEC report is that it lacks proper style and format." AEHS commenters did not like the extensive use of acronyms and "boilerplate" text.

2) The FRG assumed much lower PCB concentrations in fish than the WDNR as a result of: (1) the use of fillet data only (WDNR used skin-on); (2) omission of carp and other bottom feeders from data set; and (3) erroneous assumptions in data distributions used in stochastic modeling.

3) Neither risk assessment considered pregnant women or nursing infants as sensitive subpopulations.

4) WDNR did not evaluate anglers that might use different preparation methods (e.g., reduction factor is low) or consume whole fish – this may underestimate PCB concentrations. However, WDNR did not assume declining fish concentrations – which may overestimate PCB concentrations.

5) WDNR did not weight the fish data according to fish species preferred for consumption.

6) Use of fish tissue data from a 20-year time frame may present problems with data consistency and quality. Use of more recent fish data in the WDNR focused assessment allows better comparison to results of FRG assessment.

7) Higher fish consumption rates used by WDNR (based on Wisconsin and Michigan studies) are reasonable.

8) WDNR assumes that all recreationally caught fish are from the Lower Fox River and Green Bay, which is not supported by the survey data.

Response

In the 2001 draft BLRA, the specific concerns of the AEHS were addressed. Specific responses are as follows:

1) General Comment 1 does not require a specific response, but responses to other comments address several of the inconsistencies between WDNR's assumptions and FRG's assumptions. Responses to General Comments 2, 3, and 4 are provided below.

2) The commenters stated that WDNR did not evaluate the potential for prenatal or perinatal effects from PCB exposure. ATSDR's Toxicological Profile for PCBs (2000) provides detailed information on the toxic effects of PCBs to fetuses, infants, and children (refer to Section 3.7). This document emphasizes the fact that predicting effects is extremely difficult because there are so many variables. There are critical periods of structural and functional development during both prenatal and postnatal life, and a particular structure or function will be most sensitive to disruption during its critical period. There are no generally accepted methods to quantify PCB effects for *in utero* exposures or to nursing infants. However, WDNR qualitatively discussed effects of PCBs to the fetus, infant, and child by summarizing the results of various epidemiological studies.

3) The commenters also commented that WDNR did not evaluate neurological/developmental effects from short-term, high-level exposure. While it is possible to evaluate the effects of PCBs to pregnant and nursing women using a shorter exposure duration, it is difficult to quantify the effects this exposure may have on the fetus or infant. Once again, WDNR discusses these types of effects qualitatively in the literature review.

4) The point estimate approach was selected over stochastic modeling for the Pre-Draft BLRA. It includes a wide range of calculated results for the two most sensitive receptors, the recreational angler and the high-intake fish consumer. Two RME scenarios have been assessed; one using upper-bound concentrations and the second using average concentrations, and a CTE scenario was assessed. Furthermore, the focused evaluation of PCBs from fish ingestion explored a wide range of exposure scenarios incorporating various intake assumptions and PCB concentrations. As part of the focused evaluation, a probabilistic risk assessment of exposure assumptions for the recreational angler and high-intake fish consumer was conducted and was summarized in the Pre-Draft BLRA Section 5.9.6 and detailed in Appendix B1. The probabilistic evaluation analyzed the influence of variability by developing probability distributions for exposure parameters including fish concentration, fish ingestion rate and exposure frequency,

reduction factor, exposure duration, and body weight. WDNR and EPA feel the range of evaluations presented in this assessment sufficiently illustrates potential risks for average to high-end receptors. Importantly, EPA guidance specifies that point estimates of risk be used as the principle basis for decisions regarding the need for remedial action at a site (p. 5-120).

5) Commenters stated that WDNR's fish ingestion rates and predicted fish PCB concentrations were higher than those used by FRG. Selection of fish ingestion rates was based on literature as well as communication with various Agency personnel. The use of the two West et al. (1989, 1993) studies for exposure estimates is supported by the fact that these are regionally relevant data and these studies were specifically discussed in detail in the *EPA Human Health Exposure Factors Handbook* (EPA, 1997). Ingestion rates that are derived from studies conducted in an area where fish consumption advisories are in place are not representative of baseline conditions, which is the goal of the Pre-Draft BLRA.

Regarding the fish tissue PCB concentrations, WDNR based its representative concentrations on static (rather than declining) tissue levels. An assumption of declining fish concentrations would have to be well supported by the data in order to be certain that human health was being adequately protected. An extensive time trends analysis was performed that indicated that fish tissue concentrations were not consistently declining for species that are routinely consumed by humans. In the absence of statistical confirmation that tissue concentrations were declining, exposure concentrations were assumed to be static, which resulted in higher concentrations that those predicted by FRG.

Responses to some of the specific comments are also provided.

1) Comment does not require response.

2) Comments do not indicate that the fish PCB concentrations used by WDNR are overly conservative, just that they are much higher than the concentrations used by FRG. Comments supported some of WDNR's methodologies. We believe it is appropriately conservative to include skin-on fillet data and data from bottom-feeding fish such as carp in the data set. The assessment must address populations of fish consumers that eat different types of fish and use a variety of preparation methods. The justification for using static values rather than declining concentrations was provided in the response to General Comment 4.

3) Consideration of pregnant women and nursing infants was not quantitatively addressed in either the WDNR or FRG risk assessments. These exposures were not quantified because guidance is not available

and there is a large degree of uncertainty when attempting to estimate such intakes. This subject was discussed in more detail in the response to General Comment 2.

4) While WDNR did not consider fish preparation methods that have little reduction effect on the PCB concentrations, they did examine a wide range of fish consumption scenarios intended to represent RME. Use of lower reduction factors may be balanced out by use of more upper-bound representation of fish PCB concentrations.

5) Fish data were not weighted according to fish species preferred for consumption. This approach is protective of subpopulations that consume "less preferable" species, such as carp and other bottom feeders. People do eat carp and this is demonstrated by the number of websites dedicated to finding and preparing carp for human consumption. Examples of these websites include: www.carpanglersgroup.org, www.carp.net, www.carpuniverse.com, and www.carpdreamfishing.com.

6) WDNR included all fish tissue data that were available in the baseline assessment in an effort to be thorough. It was recognized, however, that data collected so long ago were of questionable quality. Therefore, the focused assessment provided an evaluation of data from the most recent decade of sampling. Conducting a variety of data evaluations enabled us to look at a range of results.

7) This comment indicates that the fish consumption rates used by WDNR (based on Wisconsin and Michigan studies) are reasonable. While no response is required, it might be important to note this third-party comment, especially in light of the other comments received, that these rates are not representative of the study population.

8) While it is likely true that anglers would not consume sport-caught fish that is entirely from the Lower Fox River and/or Green Bay, this is a conservative assumption. It also provides a basis for comparison of the risks from each reach and zone.

Summary of Ecological Comments

For the ecological risk assessment, four general comments, or "critical findings," were made by AEHS:

1) This comment indicates WDNR ignored field studies and chose the most conservative values in most cases.

2) Commenters stated that, regarding the process for ecological evaluation defined by EPA, WDNR addressed primarily steps 1 and 2, with little development of other steps. It is the conclusion of the panel

that, if these steps were integrated, a more scientifically defensible risk assessment would result.

3) Commenters stated that in handling data, WDNR utilized the 95 percent UCL in a normal distribution, calculating this value with data collected over approximately a 10-year period. Without appropriate statistical analysis, a normal distribution cannot be assumed.

4) Commenters stated that TRVs from WDNR are very conservative and it is unclear in some cases, for the basis of the TRVs.

Response

1) The February 1999 draft of the BLRA did not include a discussion of field studies, but currently the BLRA does include a discussion of field studies within the risk characterization section (Section 6.5.4).

2) The February 1999 draft of the BLRA did not include a discussion of field studies, population levels, USFWS NRDA investigations, and most importantly exposure modeling for birds and mammals had not been conducted or evaluated. The current version of the BLRA does include a discussion of each of these.

3) The 95 percent UCL calculation was modified to be specific to the data distribution – either normal or lognormal. If the data distribution did not fit either a normal or lognormal pattern, the normal 95 percent UCL was used as a default.

4) In the interim period between the 1999 draft and the present draft of the BLRA, much time was spent collaboratively selecting and better documenting the selection of the site-specific TRVs.

References

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3.4 Sediment Quality Thresholds

Master Comment 3.19

Commenters stated that the October 2001 BLRA calculates inappropriate and overly conservative SQTs based on unrealistic human health scenarios and conditions present in a different reach of the River than OU 1.

Response

WDNR and EPA disagree with this comment. Multiple SQTs are developed and model-calibrated in each individual reach. From the SQTs, a range of remedial action levels were modeled and examined for achieving risk reduction by individual OU. The WDNR and EPA believe that the method used to generate SQTs is consistent with the NCP guidance and the recommendations of the NRC, and pertinent federal guidance. See also *White Paper No. 11 – Comparison of SQTs, RALs, RAOs and SWACs for the Lower Fox River.*

Master Comment 3.20

The WDNR received comments related to how sediment to water ratios were calculated and used in determining SQTs. One comment suggested that the limited data presented for developing the sediment to water ratios indicated that there could be a trend in decreasing ratios moving downstream (ratio around 10^{-6} upstream of Little Rapids; around 10^{-5} below Little Rapids). This commenter further asserted that this change, if real would seem consistent with the upstream sections being the source, releasing PCBs to the surface water, hence lower ratios, while downstream is a sink with higher (non-equilibrium) PCB concentrations in the water carried down from upstream.

Another comment focused on the data presented in Table 7-7. This table lists different sample years for the sediment and water data within each reach and, therefore, indicates that the water and sediment data are not synoptic. The commenter noted that this situation raises specific concerns including:

1) Whether and how sediment and water collections were matched?

2) How much of the variation in water (filtered) was related to collection location or seasonality or flow?

3) Were the sediment concentrations based on point (0- to 10-cm) samples?

4) Was the sampling distributed over the entire reach or focused on particular areas?

5) What is represented by the "average" (arithmetic or geometric mean of all sample data)?

6) How are variations in organic carbon content of sediments and water (dissolved and suspended matter) incorporated into the ratio calculations? The implication by the statement on page 7-8, paragraph 3, which notes that Zone 2 has "different total organic carbon (TOC) concentrations in sediment", is that the model has been revised to incorporate TOC as a variable.

7) Was the maximum ratio based on the highest sediment and lowest water concentration (or highest to highest)? Note that if the maximum ratio is based on the ratio of the highest values, then the ratio is not really a "maximum" – likewise for minimum and mean ratios.

Response

Because the sediment and water data were not collected synoptically and because there are few data available, it can not be determined whether there are any trends in the sediment-to-water ratio in moving from upstream to downstream locations. Regarding the specific comments related to Table 7-7, questions 1 through 4 cannot be answered from the data that were extracted from the FRDB. Rather, these questions would require a detailed investigation of original reports that were reviewed to compile the FRDB. To answer question 5, the average concentrations represent arithmetic mean concentrations. To answer question 6, TOC was not considered in the calculation of the sediment-to-water ratio. Water concentrations used for the calculation of this ratio were based on estimated total (filtered plus particulate) concentrations. Reach- and zone-specific TOC concentrations were, however, used as an input in the calibration of the FRFood Model – the model that was used in reverse to calculate SQTs. To answer question 7, the sediment-to-water ratio represented in the "Maximum" column resulted from a comparison of maximum water and maximum sediment concentrations. The same rationale was used for the calculation of minimum and mean sediment and water ratios.

Master Comment 3.21

A commenter expressed the opinion that the conceptual representation of the PCB problem at the Lower Fox River and Green Bay Site is factually inaccurate and that the Proposed Plan and supporting technical documents overstate the PCB problems.

Response

WDNR and EPA disagree with this statement. The characterization of the Site defines sources as well as current Site information and risks. The technical evaluation of remedial technologies is the appropriate level of detail needed at this point in the Superfund decision-making process. Additional sample collection and analysis will be conducted as part of the remedial design phase.

4 RAOs, SQT, and RAL Selection

4.1 RAOs

Master Comment 4.1

Several commenters, in both public and private sectors, expressed concern about the expression of RAOs in the FS and in the Proposed Plan. There were numerous questions about the intent of the RAOs, how RAOs were used, and in some cases questions concerning the wording of the RAOs.

Response

WDNR and EPA evaluated the RAOs in the Draft FS and Proposed Plan. To be consistent in final documents, the RAOs have been formulated as follows:

- *RAO 1: Achieve, to the extent practicable, surface water quality criteria throughout the Lower Fox River and Green Bay.*

  This RAO is intended to reduce PCB concentration in surface water as quickly as possible. The current water quality criteria for PCBs are 0.003 ng/L for the protection of human health and 0.012 ng/L for the protection of wild and domestic animals. Water quality criteria incorporate all routes of exposure assuming the maximum amount is ingested daily over a person's lifetime.

- *RAO 2: Protect humans who consume fish from exposure to COCs that exceed protective levels.*

  This RAO is intended to protect human health by targeting removal of fish consumption advisories as quickly as possible. WDNR and EPA defined the expectation for the protection of human health as the likelihood for recreational anglers and high-intake fish consumers to consume fish within 10 and 30 years, respectively, at an acceptable level of risk or without restrictions following completion of a remedy.

- *RAO 3: Protect ecological receptors from exposure to COCs above protective levels.*

  RAO 3 is intended to protect ecological receptors like invertebrates, birds, fish, and mammals. WDNR and EPA defined the ecological expectation as the likelihood of achieving safe ecological thresholds for fish-eating birds and mammals within 30 years following remedy completion. Although the FS did not identify a specific timeframe for evaluating ecological protection, the 30-year figure was used as a measurement tool.

- *RAO 4: Reduce transport of PCBs from the Lower Fox River into Green Bay and Lake Michigan.*

  The objective of this RAO is to reduce the transport of PCBs from the River into Green Bay and Lake Michigan as quickly as possible. WDNR and EPA defined the transport expectation as a reduction in loading to Green Bay and Lake Michigan to levels comparable to the loading from other Lake Michigan tributaries. This RAO applies only to River reaches.

- *RAO 5: Minimize the downstream movement of PCBs during implementation of the remedy.*

  A remedy is to be completed within 10 years.

Master Comment 4.2

Several commenters indicated the remedy will not achieve the RAOs due to background conditions. Further, the RAOs in the Proposed Plan compared to the FS have two changes – the phrase "as quickly as possible" has been added to three of the five RAOs and the FS references to COCs have been removed. Another commenter indicated that RAOs constitute goals and should not be qualified by "to the extent practicable."

Response

WDNR and EPA have reviewed the documents and have addressed all language inconsistencies. Concerning the achievement of the RAOs, the Agencies believe the remedy can achieve RAOs 2 and 3 dealing with fish consumption advisories and impacts to the ecosystem. Concerning RAO 4, which deals with transport from the Lower Fox River to Green Bay, the Agencies believe this will be achieved by active remediation. The term "as quickly as possible" was included in the RAOs in the Proposed Plan to indicate that the regulatory agencies believe the RAOs should be achieved relatively soon, rather than being delayed.

RAO 1, which addresses achieving water quality criteria, is the only RAO that uses the term "to the extent practicable." This purpose of the RAO is to stress the need for remediation to reduce PCBs in the water column as well as to attempt to meet water quality criteria. The term "to the extent practicable" was added due to the realization that background levels entering the study area (i.e., the water from Lake Winnebago) cannot be accurately determined due to limitations of available analytical methods. Surface water quality standards in Wisconsin are 0.003 ng/L for protection of human health and 0.12 ng/L for the protection of wildlife. The 1 ppm action level will result in a reduction in surface water PCB concentrations of greater than 90 percent within the Lower Fox River.

Master Comment 4.3

Some commenters suggested the addition of a sixth RAO concerning habitat enhancement. The premise offered was that any final remediation strategy for the Lower Fox River achieve a balance between the benefits of sediment remediation and other ecosystem restoration alternatives.

Response

WDNR and EPA both believe that environmental restoration is a critical component to the remediation of the Lower Fox River and Green Bay. It is also a requirement of the Superfund law. It is the Agencies' position that removal of PCB-contaminated sediment is the first, and most important step, for environmental restoration in the Lower Fox River.

Habitat restoration is the function of the NRDA program, which has been an integral part of the overall Lower Fox River management. The state, working with the federal resource trustees, has already begun working with various responsible parties to initiate restoration activities. However, it is also important to note that the law requires that these restoration activities must be undertaken with the trustee agencies and not the remediation agencies through the NRDA process. As such, the restoration actions are not part of the ROD. It is the aim of the state to achieve a single global settlement with all responsible parties, as well as the trustee agencies, so that a comprehensive agreement is achieved that covers both remediation and restoration activities.

Master Comment 4.4

RAO 4 states that an objective of remediation is to reduce transport of PCBs from the Lower Fox River into Green Bay. Some commenters stated that this RAO is arbitrary in that it excludes other remedial alternatives from consideration. They contend that modeling supported by WDNR predicts no measurable benefit in the Bay from remediation of the River.

Response

WDNR and EPA strongly disagree with this comment. The intent of RAO 4 is to reduce the PCB transport to Green Bay from the Lower Fox River. An objective of this RAO is to remove the PCBs from the River where they are more readily accessible for remedial management, rather than wait until the contaminants have migrated out into the Bay where they are more dilute and more expensive to remediate. As is discussed in Section 5.6 of the RI, anywhere from 125 to 220 kg (275 to 485 pounds) of PCB mass is exported from the Lower Fox River to Green Bay on an annual basis. Furthermore, based on the models used by WDNR in evaluating transport from the River to the Bay, it is estimated that there will be a greater than 90 percent reduction in annual loading of PCBs to the Bay if the remediation in the Proposed Plan is implemented.

Reduction of the contaminant loading from the Lower Fox River to Green Bay and Lake Michigan is a fundamental goal of this Superfund action, and active remediation in the River and Bay will reduce long-term risks to human health and the environment. The need for remediation is well supported by the current risks documented in the BLRA from PCBs in the Lower Fox River and Green Bay. In addition, RAO 4 directly supports the Lake Michigan Lake-wide Management Plan's (LaMP's) (EPA, 2000) basic principle to: "Reduce loadings and emissions of LaMP critical pollutants to the Lake Michigan ecosystem and remediate contaminated sediments within the 10 Areas of Concern in the Lake Michigan basin; utilize the LaMP process to develop reduction targets (building on the Lake Michigan Mass Balance Study and the Binational Strategy); and achieve substantial reductions in human and ecological health risks in the basin." While treatment is not proposed herein, reduction of mobility can be achieved through removal of contaminants from the environment and placing them in a contained structure (i.e., landfill).

Contrary to the comment received, WDNR's modeling does show improvements to the Bay. For example, as documented in the FS Table 8-10, with a combination of a 1 ppm action level for the River and in the Bay reduces the time to the CTE cancer risk of 10^{-4} to 3 years. This compares to no action in the River and Bay taking 83 years to achieve this risk level.

Reference

EPA, 2000. *Lake Michigan Lake-wide Management Plan*. United States Environmental Protection Agency Website: http://www.epa.gov/grtlakes/lakemich/.

Master Comment 4.5

Several commenters noted that the any remedial plan for the Lower Fox River must also protect Lake Michigan, and not just local environments.

Response

WDNR and EPA believe this plan goes a long ways in protecting Lake Michigan in that the remedy in the ROD will significantly reduce the single largest source of PCBs being discharged into Lake Michigan. This effort along with the combined effects of successful remediation at other remedial sites along the shoreline and water discharging to Lake Michigan will contribute to the lake's overall protection.

4.2 SQTs and SWACs

Master Comment 4.6

A commenter stated that the Proposed Plan applies SQTs as an RAL everywhere in the sediment, not at the surface.

Response

Based on comments from the EPA's National Remedy Review Board, the Agencies defined a range of cleanup levels, known as the RALs rather than the single risk-based SQT as was presented in the WDNR February 1999 draft RI/FS. As such, all sediment exceeding a specific RAL was identified for remediation. Application of an RAL to sediment at depth recognizes the Agencies' position that future conditions can cause PCBs at depth to become exposed to the water column or biota. The effects from removal, containment, or non-removal of contaminants and potential exposure from surface sediments are reflected in modeling estimates for evaluated receptors (FS Section 8).

Master Comment 4.7

Commenters stated that the Proposed Plan applies the 0.25 ppm SQT, derived from OU 4 to the entire River rather than calculate the risk that PCB-containing sediments present for the biota for each reach. The Proposed Plan should consider different action levels for different reaches and the sediment-to-water ratios derived for OU 4 should not be applied to the whole River.

Response

In selecting the appropriate action level for OU 1, WDNR and EPA applied an approach that balanced risk reduction for human health and the environment, as well as the residual SWAC and the resulting human health and ecological SQT for each OU. For determination of RALs, WDNR and EPA also considered cost as well as long-term effectiveness. For OU 1, the 1 ppm action level resulted in the most appropriate level of risk reduction. Sediment to water ratios were developed for all four reaches of the River and for Green Bay. The general term used to estimate SQTs was not from OU 4, as the commenter implies, but rather a value of 10- was determined to be a good estimation of the range of values observed. As documented in Section 7 of the BLBA, sediment to water ratios averages ranged between 10-4 to 10-7 for all operable units, and average 10-5 in OUs 3 and 4, to 10- in OUs 1, 3, and Zone 2 of Green Bay. See Section 9.6 of the Proposed Plan and *White Paper No. 11 – Comparison of SQTs, RALs, RAOs, and SWACs for the Lower Fox River*.

Master Comment 4.8

The differences between SQTs, SWACs, and RALs were commented on by numerous parties. How the SQTs, derived in the risk assessment, translated into SWACs, the multiple RALs examined in the FS, and how ultimately the Agencies selected an RAL of 1 ppm was questioned. Commenters stated that the Proposed Plan calculates a single SQT for one reach and then applies the number uniformly to all reaches, though all areas do not contribute equally to the PCB exposure.

Response

PCBs were identified as the principal contaminant causing or potentially causing risk to human health and the environment. In order to translate risks to human health and the environment into a cleanup goal, it became necessary to relate risks with sediment concentrations of PCBs. Three separate but related risk and remedial action numbers were generated in the BLRA and FS. These are as follows:

- **Sediment Quality Thresholds** were developed that linked single-point concentrations of PCBs to specific risks to human health and the environment.
- **Surface-Weighted Average Concentrations** related the risk estimates developed in the SQT to the entire area of the OU (e.g., Little Lake Butte des Morts, De Pere dam to Green Bay).
- The **Remedial Action Level** is the engineering design level around which the removal or containment alternative is structured. The RAL is selected so that when the cleanup is achieved, the SWAC is also achieved.

The development and relationship of SQTs, SWACs, and RALs are detailed in Section 7 of the BLRA, Section 5 of the FS, and are further discussed in *White Paper No. 11 – Comparison of SQTs, RALs, RAOs, and SWACs for the Lower Fox River*.

SQTs should be considered as receptor-specific point estimates (i.e., they are calculated for a specific sediment location, pathway, and receptor). The SQTs themselves are not cleanup criteria, but are a good approximation of protective sediment thresholds and were considered to be "working values" from which RALs were selected. SQTs do not vary by OU, but may vary by Superfund site, given the type of contamination, the types of species, site-specific exposure potential, the location-specific information available at a specific Superfund site, etc. WDNR and EPA believe that the SQTs developed for the Lower Fox River and Green Bay Site apply site-wide.

The SWAC is the concentration of PCBs in sediments calculated as an average over the entire surface area of an OU. In the FS, SWACs were calculated for baseline risk and for post-remedial actions based on a series of evaluated RALs (e.g., 0, 0.125, 0.25, 0.5, 1, 5 ppm). The current or residual SWAC could be compared to the SQTs to determine which species were or were not at risk over the entire OU. Figure 1 in *White Paper No. 11 – Comparison of SQTs, RALs, RAOs, and SWACs for the Lower Fox River* provides a convenient reference comparing the SQTs, SWAC, and RALs.

Commenters often appeared to have confused the SQTs and the RAL of 1 ppm selected by WDNR and EPA for each OU. The distinction is articulated in *White Paper No. 11 – Comparison of SQTs, RALs, RAOs, and SWACs for the Lower Fox River*. SQTs were developed for individual receptors at varying risk levels for each OU in Section 7 of the BLRA. The RAL was selected based upon several considerations for each reach that included: (1) residual SWAC; (2) time to achieve risk management goals; (3) ability to achieve all RAOs; (4) overall contamination cost of the remedial action; and (5) other considerations. A further explanation and rationale for the selected RAL is discussed in the ROD.

Master Comment 4.9

RALs developed in the October 2001 Draft FS based on SQTs does not comply with NCP, as SQTs were derived from modeling of an average set of conditions in one reach with greatest risk and applied to all reaches. These commenters also argued that the SQT applies to the top 10 cm, and should be translated to SWAC.

Response

WDNR and EPA strongly disagree with this comment. Development of the SQTs, SWACs, and RALs is fully in compliance with the NCP, and is responsive to the NAS Board's recommendation of developing site-specific risk assessments and cleanup values. The commenter is incorrect in stating that SQTs were developed in one reach and applied to all reaches. The SQTs were developed and tested for all reaches. Furthermore, the SQT is applied only in the areas where organisms are exposed (i.e., the top 10 cm), and the SWAC is compared directly to the SQTs for both human and ecological receptors. See also the response to Master Comment 3.19 in Section 3.

4.3 Selection of RAL

Master Comment 4.10

Several commenters expressed agreement with the Proposed Plan Alternative C, which includes the removal of sediment with PCB concentrations greater than 1 ppm RAL using a hydraulic dredge, followed by off-site disposal of the sediment.

Response

Comment noted.

Master Comment 4.11

A commenter expressed disagreement with the Proposed Plan monitored natural recovery plan for OU 2 and indicated that "hotspots" within the OU should be remediated to a lower RAL (0.25 or 0.125 ppm) even if the unit cost to remove PCBs were significantly higher.

Response

The WDNR and EPA do not support the need for active remediation in OU 2 and believe MNR is the appropriate response action. Remediation to the level suggested by the commenter would not likely result in a substantial risk reduction. This is because, in part, it would be, at best, difficult to achieve concentration reductions for many of the OU 2 deposits, due to bedrock underlying contaminated sediments. Furthermore, the mass of PCBs (109 kg) and volume of contaminated sediment (339,200 cy) for these deposits are relatively small when compared to the PCB mass and contaminated sediment volume in the rest of the River. The current SWAC for OU 2 is 0.61 ppm. Furthermore, two deposits, N and DD, within this OU account for over 50 percent of the PCB mass. The WDNR has already addressed Deposit N and Deposit O. The Agencies will decide on Deposit DD when the ROD for OUs 3 through 5 is released.

Master Comment 4.12

Some commenters supported the cleanup standard of 0.25 ppm which was included in the February 1999 RI/FS.

Response

WDNR and EPA selected the 1 ppm RAL based on an evaluation of action levels with the residual SWAC for each OU and the ability of the action level to meet the RAOs. The Agencies in particular considered the time to achieve removal of fish consumption advisories, as well as the reduction in impacts to the ecosystem. The 1 ppm RAL is the best mechanism for achieving these goals. This is consistent with the process identified in the Proposed Plan. WDNR and EPA do not believe this is inconsistent with what was called for in the 1999 Draft RI/FS. The 1999 Draft RI/FS called for an action level of 0.25 ppm or a 0.25 ppm SWAC with neither being selected. The SWAC value resulting from the 1 ppm action level is 0.19 ppm in OU 1. For further discussion, please review the supporting document that explains the relationship of the RAL to the SWAC and *White Paper No. 11 – Comparison of SQTs, RALs, RAOs, and SWACs for the Lower Fox River*.

Master Comment 4.13

Commenters stated the PCB sediment cleanup target must be strengthened and lowered to either 0.5 or 0.25 ppm PCBs. The commenter stated that more stringent cleanup levels have been chosen at other sediment sites such as Sheboygan. The commenters' opinion is that a lower hotspot cleanup level is needed to protect human health and to achieve the average sediment levels necessary to lift the fish consumption advisory. Other commenters suggested that the Proposed Plan applies a 1 ppm RAL to OU 1 based on factors other than risk.

Response

WDNR and EPA carefully considered more and less stringent cleanup levels (RALs) before arriving at the 1 ppm level in the ROD. This cleanup standard is not arbitrary and the Agencies gave careful consideration to what is needed to be protective and meet the RAOs. The selection of the cleanup level is the outcome of a complete and scientifically based risk evaluation. In selection of the 1 ppm RAL, WDNR and EPA considered RAOs, model forecasts of the time necessary to achieve risk reduction, the post-remediation SWAC, comparison of the residual concentration to SQTs for human and ecological receptors as well as sediment volume and PCB mass to be managed, as well as the cost. This is discussed further in the ROD.

Multiple RALs were considered for each OU, no action, 0.125, 0.25, 0.5, 1, and 5 ppm. Model forecasts were used to compare the projected outcomes of the remedial alternatives using various action levels with the RAOs, primarily RAOs 2 and 3, which deal with protection of human health and the environment. On the basis of that analysis and to achieve the risk reduction objectives using a consistent action level, 1 ppm was agreed upon as the appropriate RAL.

In OU 1, the time needed to reach the endpoints for risk reduction varies by receptor from less than 1 year to an estimated 29 years. As was pointed out in earlier documents (e.g., the Proposed Plan), the upstream reach achieves risk reduction faster than does the area around the mouth of the River. The SWAC in OU 1 is a measure of the surface (upper 10 cm) concentration and would be 0.19 ppm if all material greater than 1 ppm can be removed. The SWAC value provides a number that can be compared to the SQTs developed in the BLRA. SQTs are estimated concentrations that link risk in humans, birds, mammals, and fish with safe threshold concentrations of PCBs in sediment. A comparison of the SWAC and SQT values shows that there is overlap of the various SQT values for recreational anglers, high-intake fish consumers, and wildlife, and the SWAC value for the OU 1.

Master Comment 4.14

Commenters expressed the concern that the use of an RAL rather than a SWAC-based cleanup value weakens the connection between the remedy chosen for OU 1 and the risk caused by that reach.

Response

WDNR and EPA have chosen to use the RAL-based approach for consistency with each OU. For all OUs, the resulting SWAC was evaluated to determine whether the RAL and resulting SWAC is protective of human health and the environment. The 1 ppm RAL and resulting SWAC for OU 1 does result in implementation of a remedy that is sufficient to meet this standard. Furthermore, since OU 1 is the furthermost upstream reach of the River, it inherently makes sense to ensure that the sediments in this reach will no longer be a continuing source to the downstream reaches. See also *White Paper No. 11 – Comparison of SQTs, RALs, RAOs, and SWACs for the Lower Fox River*.

Master Comment 4.15

One commenter stated that the remedy of OU 1 in the Proposed Plan is too extensive in that the remedy requires the removal of all sediment with a PCB concentration greater than 1 ppm, regardless of depth, overlying concentration, or stability of sediment beds.

Response

The commenter misconstrues the removal action in OU 1. The remedial footprint shown in Section 7 of the FS is based upon sediment concentrations of PCBs that exceed 1 ppm. It is inaccurate to represent that an area is targeted for removal where surface sediments do not exceed the Proposed Plan RAL. What is true is that within that remedial footprint, removal continues throughout the vertical profile until all sediments exceeding the RAL are extracted.

The stability of sediments in Little Lake Butte des Morts has not been established with sufficient certainty to ensure contaminants would remain permanently buried. Furthermore, it has not been evaluated, documented, or established that a thin layer of less contaminated material over more contaminated sediments make contaminants unavailable to the food chain.

Master Comment 4.16

A commenter indicated that the remediation standard of 0.25 ppm for cleanup is arbitrary.

Response

This comment is not clear. It is possible the person was referring to the February 1999 RI/FS. WDNR and EPA did use a range of RALs from 0.125 to 5 ppm in the FS. Derivation of the RALs, and corresponding SWAC are discussed in Section 5 of the FS. Remedial alternatives were constructed for each River reach or Bay zone in Section 7 of the FS, and were evaluated for cost, risks, and compared to the CERCLA threshold and balancing criteria in Sections 8 through 10. For the Proposed Plan, EPA and WDNR selected an RAL of 1 ppm based upon careful, deliberate consideration of the permanence, risk reduction, public acceptance, and costs presented in the FS.

The 1 ppm RAL cleanup standard is a risk-based cleanup standard and is considered protective. The 0.25 ppm level from the February 1999 RI/FS was a preliminary number considered both a resulting SWAC and a complete removal of that action level. The SWAC for a 1 ppm RAL as presented in the Proposed Plan actually produced a SWAC of 0.185 ppm for OU 1. Thus, if the comparison is to the original 0.25 ppm SWAC the cleanup standard is, on average, lower than the original preliminary cleanup number. Regardless of the comparison, the most current evaluation in the BLRA shows that the proposed cleanup standard is protective in any event. The proposed RAL will remove fish advisories in OU 1, while the 0.25 ppm RAL would remove fish advisories in a shorter period.

Master Comment 4.17

Commenters suggested that the RAL of 1 ppm does not meet the human health and ecosystem goals of the remedial plan.

Response

WDNR and EPA disagree with this comment. The basis for selection of the RAL was clearly identified in the Proposed Plan and is further explained in the ROD.

Master Comment 4.18

One commenter expressed disagreement with the Proposed Plan's Alternative C2, which includes the removal of sediment with PCB concentrations greater than the 1 ppm action level using a hydraulic dredge, followed by off-site disposal of the sediment. The commenter expressed concern that with an RAL of 1 ppm, it will take 20 years to remove the walleye fish advisory and 29 years to remove the carp advisory, which is significantly higher than the upstream areas of the River that are cleaned to 1 ppm. The commenter supported a cleanup action level of 0.25 ppm, which would reduce the removal of the walleye advisory to 8 years and the carp advisory to 9 years.

Response

As noted in Master Comment 4.12, the RAL of 1 ppm was derived by balancing multiple considerations. The nine evaluation criteria under CERCLA required WDNR and EPA to balance risk reduction against such factors as community acceptance, implementability, and permanence of the remedy, and with the overall cost of the remedy. Both more stringent and less stringent criteria were evaluated, but after consideration, the 1 ppm RAL was selected.

Master Comment 4.19

One commenter suggested that a better way of evaluating sediment remediation areas would be to use an approach of PCB mass per unit area similar to that conducted on the Hudson River.

Response

WDNR and EPA disagree with this comment. For Superfund sites, site-specific determinations are generally required. Conditions and characteristics as well as available data are critical considerations in how cleanup levels are determined as well as what cleanup levels are appropriate for each site. These considerations include impacted media and potential exposures, contaminant toxicities and concentrations, the nature of risks to human health and the environment, and the quality and type of available data. Specific characteristics for sediment sites also include horizontal and vertical contaminant distribution, sediment thickness and physical characteristics, relationships between media (i.e., sediments and ground/surface water, biota, and air), and potential for releases and exposures. These all factor into determination of the most effective and protective use of available information to estimate and measure potential site risks. For the Lower Fox River Site, an RAL defining a specific vertical and horizontal target area, combined with the SWAC, were determined to be the most appropriate, protective, and feasible approach in estimating and measuring site risks.

The suggestion by the commenter reveals a fundamental misunderstanding of the differences between the RAOs for the Lower Fox River and the Hudson River. The RAOs for the Lower Fox River specifically called out the protection of individuals and ecological receptors that eat fish. For the Hudson River, two general RAOs were developed pertaining directly to sediments: "reduce the inventory (mass) of PCBs in sediment that are or may be bioavailable, and minimize the long-term downstream transport of PCBs in the river." The Hudson RAOs resulted in the selection of mass per unit area criteria for the selection of remedial areas. The Hudson Responsiveness Summary (EPA, 2002) acknowledged that the mass criteria do not allow for direct comparison with the sediment thresholds, nor to direct comparison to reduction in fish tissue concentrations. Given that, the Hudson approach is not appropriate to the Lower Fox River.

In addition, as part of the mass per unit area analysis, the commenter has mentioned thresholds to identify "hot spots" and "expanded hot spots." The commenter has failed to include Deposit A under the expanded hot spot category as the mass per unit area estimated by the commenter is 3.7 grams per square meter (g/m^2), which is greater than the expanded hotspot threshold (3 g/m^2). Also, the commenter has mentioned on page 16 of the comments, "PCB mass per unit area for different sediment deposits, and then focus on those deposits with the most concentrated mass." However, from the mass per unit area numbers provided by the commenter, it appears that surficial PCB mass over a particular reach has been simply converted to calculate PCB g/m^2. This approach appears to provide results that average the PCB mass across the entire reach and does not truly represent an area with the most concentrated mass.

Reference

EPA, 2002. *Responsiveness Summary – Hudson River PCBs Site Record of Decision*. Prepared for United States Environmental Protection Agency, Region 2 and United States Army Corps of Engineers, Kansas City District by TAMS Consultants, Inc. January.

5 Technical Evaluation and Remedial Alternative Development

5.1 Effectiveness of Dredging

5.1.1 Sediment Technologies Memorandum

Master Comment 5.1

Appendix B of the FS, the *Sediment Technologies Memorandum*, provides a review of several dredging projects. Comments were submitted that suggest that the review examined only projects that dealt with mass removal, did not address the issues of risk reduction, short-term effectiveness, and applicability to the Lower Fox River.

Response

The commenter misrepresents the objectives and findings of the *Sediment Technologies Memorandum*. A continuing theme presented by opponents of removal options for the Lower Fox River is that historical environmental dredging programs have all failed to reduce risks to human health and the environment. In comments submitted to both the 1999 and 2001 RI/FS documents, the commenters list "failures" in several environmental dredging projects, without presenting the stated construction and environmental management goals. Citing a limited number of cases, these critics suggest that dredging has limited exposure reduction benefits, and may increase rather than decrease contaminant exposure. However, their assertions never examine the underlying reasons for short-term deficiencies (e.g., poor dredging design, contractor quality control, etc.), and the long-term positive effects of removal actions at other contaminated sediment sites are ignored. This application of risk goals ex post facto to remedial programs that were managed otherwise is misleading.

The *Sediment Technologies Memorandum* documents the process of acquiring all management and construction documents related to a project. The projects represented were not "carefully screened," as is suggested by the commenter. Rather, only those projects that had clear and adequate documentation associated with the purpose and outcome were used. The commenters fail to acknowledge that over 60 projects were screened for data adequacy before settling on the 20 projects reviewed.

The FS Appendix B, case study review, addressed two questions: (1) whether dredging can physically be implemented and meet the target performance goals established for a project, and (2) whether long-term risk reduction benefits (i.e., reduced fish tissue concentrations) were observed over time. To answer these questions, each case study was evaluated for both short-term and long-term goals. Both questions are valuable when determining the implementability and feasibility of dredging as a possible remedial alternative. Short-term evaluations looked at monitoring parameters such as: surface water quality during dredging, air quality during dredging, surface sediment concentrations immediately after dredging, the contaminant mass and/or volume of sediment removed when compared to design specifications, and perceived success of the equipment used when compared to Site conditions. Long-term evaluations looked at monitoring parameters such as: surface sediment concentrations, bioassay toxicity, and fish tissue concentrations over time.

The success of long-term risk reduction can be quite subjective and the outcome of site-specific projects can be viewed in many different ways depending on the criteria applied by the evaluator. An example of the misrepresentation the *Sediment Technologies Memorandum* sought to address is included within the FRG's comments to the 2001 RI/FS. Within their Table 1, several projects, including the Fox River Deposit N, are compared to "Post Remediation Confirmation PCB Levels," with the inference that these failed to meet cleanup goals. In all of those cases listed, the project was intended to be a mass removal, not removal to a cleanup goal. Those projects were successful from the standpoint of their environmental management and construction goals.

In reviewing outcomes at other Superfund sites, it should be noted that PCB residual concentrations actually attained at these other locations were dependent, in part, on the cleanup goal set there. For example, at the Manistique River Site, the cleanup goal was to remove 95 percent of PCB mass and achieve an overall average residual concentration of less than 10 ppm after dredging. Therefore, the residual PCB concentration at this location should not be expected to be 1 ppm since the targeted level was actually higher. Another example, the Lower Fox River pilot demonstration project at Deposit N, the cleanup goal was to remove the impacted sediment down to within 6 inches of bedrock, understanding that the final 6 inches would be difficult to dredge effectively. With the bulk of the PCB mass removed in an "unstable section of the Lower Fox River, long-term risk reduction via reduction exposure is anticipated."

To standardize the way WDNR perceived "risk reduction success" of individual projects and eliminate potential bias, WDNR applied the values and goals established by the local regulators and communities directly managing a particular project when determining "success." WDNR did not "mask the results of the 20 case studies" as perceived by commenters, but instead, described the current status of all 20 projects relative to risk reduction. Some projects are inconclusive (with no trends observed), some projects show declining trends but more data and time are needed to validate the trends, and some projects are considered to have achieved adequate risk reduction by local regulators.

Finally, an important finding of the *Sediment Technologies Memorandum* was the inadequacy (or lack thereof) of the monitoring programs associated with the post-remedy. A common shortcoming of many sediment remedies, whether it is dredging, capping, or natural recovery, is whether or not the monitoring program could detect trends of risk reduction to biotic resources over time. Another conundrum is that many of the large-scale dredging projects cited by commenters have been completed in the last 10 years, and therefore not enough time has passed to filter out natural temporal variability in site conditions and populations. This observation was also stated by the NRC as "Long-term monitoring results are sparse, in part because most active management efforts were conducted within the past 5 years, and only a few were conducted as long as 10 years ago…there are significant disincentives to conducting long-term monitoring…and available monitoring information has been gathered mainly during implementation…" (NRC, 2001). In some cases, multiple lines of evidence may be needed to detect trends of post-remedy risk reduction.

In terms of application to the Lower Fox River, Appendix B of the FS also looked at short-term goals to assess the implementability of dredging as a remedial alternative. Based on our findings, it appeared that dredging could feasibly be implemented and still meet the design criteria set forth in the projects (i.e., residual concentrations, air quality, surface water quality, community support). Based on these "positive" findings, dredging was retained as a possible alternative in the Lower Fox River FS. Appendix B of the FS also looked at long-term goals of risk reduction to assess the long-term effectiveness of dredging remedies. Based on WDNR's findings, it appeared that long-term risk reduction has been achieved at some projects, but others still required more time, and/or better monitoring to confirm. In some cases, different cleanup levels and/or remedies may be required to achieve long-term risk reduction in a reasonable timeframe.

Reference

NRC, 2001. *A Risk-Management Strategy for PCB-Contaminated Sediments*. Committee on Remediation of PCB-contaminated Sediments. National Research Council, National Academy of Sciences.

Master Comment 5.2

Commenters asserted that Appendix B did not accurately represent the data from some of the case study sites, specifically whether risk-based criteria were achieved. They contended that despite attempts to over-dredge and with cleanup passes, the removal actions did not achieve risk reduction for several of the projects listed.

Response

Several of the remedial dredging projects that commenters claimed did not achieve risk reduction involved sites where contaminated sediments were underlain by hard substrate. This site-specific condition prevented over-cutting of contaminated materials, a strategy that could have led to significantly lower PCB residuals. These same issues, projects, and appropriate responses can also be found in the Hudson River Responsiveness Summary Master Comment 579.

WDNR notes that it may not always be feasible to use over-dredging to improve removal efficiency. As noted at Deposit N, the hard substrate prevented over-dredging. However, as identified in the FS, over-dredging of sediments will be accomplished only when possible. There are several areas within the dredge footprint of the River where sediments will be dredged to hard bottom that eliminates the need for over-dredging. The residual contamination depends on a number of factors that include depth and type of materials underlying the dredge footprint, average PCB concentration of sediments, depth of cut, and cleanup goal for project. These conditions are site-specific and vary by project. Results from the *Sediment Technologies Memorandum* (FS Appendix B) indicate that dredging can be implemented in an effective way if the technology is designed and managed appropriately for the site conditions. Recent advances in dredge head construction and positioning technology enable accurate removal of sediment layers with minimum incidental over-dredging to achieve target goals. As stated in the FS, 17 of the 20 projects mentioned in Appendix B met the short-term target goals that include sediment excavation to a chemical concentration, mass, horizon, elevation, or depth compliance criteria. Seven projects designed "over-dredge" into the project plans. In five out of seven cases, where over-dredge could occur, target goals were met.

This issue was also addressed in the Hudson Responsiveness Summary Master Comment 579, and Hudson River Responsiveness Summary White Paper 312663, Post-Dredging PCB Residuals.

5.1.2 Resuspension Effects of Dredging

Master Comment 5.3

Commenters suggested that dredging will likely result in the greatest short-term, in-river contaminant release. They cite the Deposit N project as having caused resuspension and redistribution of sediment that can be expected during implementation of the Proposed Plan. Commenters also suggested that certain areas of OU 4 are very effective sediment traps and that restricting dredging to routine navigational dredging will achieve RAOs 4 and 5.

Response

WDNR and EPA acknowledge that there will be some sediment resuspension during remediation of the Lower Fox River. However, even a very high-end estimate of loss is the 2.2 percent estimate from the SMU 56/57 project (USGS, 2000), which the commenters failed to acknowledge. Applying the loss rates from SMU 56/57, which removed the most highly contaminated sediments in the River, to the entire Lower Fox River proposed remediation (~29,500 kg) would equate to a loss of less than 650 kg of PCBs.

On the other hand, the FRG offered that the annual PCB export from July 2000 to July 2001 was up to 106 kg (Exhibit 8, Volume 4) and that the rate of decline approximates a half-life of 9 years (Volume 1, p. 51). If one accepts this rate of decline at face value and applies it to the next 20 years, almost 40 percent less PCB would be resuspended and transported to Green Bay during active remediation (650 kg) than doing nothing (1,140 kg).

WDNR and EPA do not agree with the conclusion of the commenters that navigational dredging is more effective at achieving RAOs 4 and 5 than active remediation. This is based, in part, on the following considerations:

1) The comment offered by the FRG that: "…clamshell may spill 20-30 percent of sediment during hoisting (NAS Report, p. 199–201)" (Volume 1, p. 227);

2) The commenters failed to recognize that navigational dredging in the Lower Fox River is currently performed mechanically using clamshells; and

3) The documented losses from the SMU 56/57 project (discussed above) which used hydraulic dredging.

Master Comment 5.4

Commenters suggest that the FS failed to account for remobilization of PCBs during dredging in its analysis of the protectiveness or effectiveness of dredging. The commenters suggested that WDNR provide a mass-based, dredging-induced PCB loading criteria, or provide a quantitative assessment of the actual impacts posed by these releases or expected releases during the long-term dredging project.

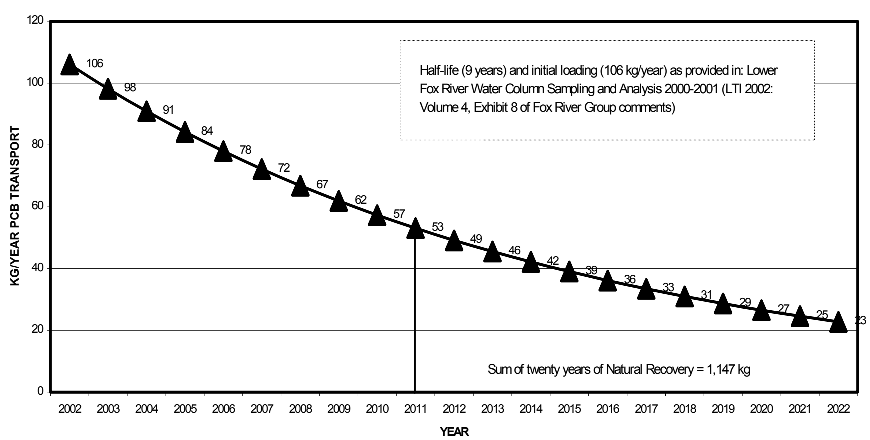
Response

WDNR and EPA believe that appropriate loading criteria from losses due to dredging should be equal to those determined during the dredging project at

SMU 56/57 (USGS, 2000). Based on these results, where the commenter acknowledged that this set of data represents the most comprehensive data set available, the PCB loss approximated 2.2 percent of the mass removed. Applying the loss rates from this project that removed the most highly contaminated sediment in the entire Lower Fox River to the proposed remediation would equate to a total loss of 644 kg of PCBs. The commenter supplied a PCB decline rate, which the Agencies believe is incorrect. However, even applying this rate of decline at face value, over the next 20 years, almost 40 percent less PCBs mass would be transported to Green Bay during active remediation (650 kg) than by the no action alternative (1,140 kg). Similarly, the target removal of 1,700 kg of PCBs from Little Lake Butte des Morts would potentially release less than 40 kg of PCBs, roughly only twice as much as one responsible party suggested is contributed annually to the loading leaving Little Lake Butte des Morts.

Relative to PCB concentrations, data collected during high-flow events or ship movements within the River have clearly shown that these actions can result in concentrations equal to concentrations found during dredging.

Figure 4 Water Column PCB Half-Life



Reference

USGS, 2000. *A Mass-Balance Approach for Assessing PCB Movement during Remediation of a PCB-Contaminated Deposit on the Fox River, Wisconsin*. United States Geological Survey Water-Resources Investigations Report 00-4245. United States Geological Survey. December.

Master Comment 5.5

Commenters offered that methods for assessing the fate and impact of PCB releases from dredging are illustrated in the recent comprehensive assessment of the issue and submitted with these comments. In addition, the commenters encourage the inclusion of dredging losses into the water quality modeling.

Response

Methods illustrated in this document relate only to the Hudson River. WDNR and EPA do agree with the commenter's statement that: "Variations in site characteristics, the components of the remedy and their relevance to the lower Fox River, the method of sediment removal, the method and effectiveness of environmental controls, volume of sediment removed, and multiple contaminants of concern make direct comparisons between "successes" at other sites to the proposed project for the Lower Fox River nearly impossible."

As for the incorporation of dredging releases into the water quality modeling, WDNR and EPA see little value in including another highly variable factor into models. Any differences between model results with or without the 2.2 percent dredging losses observed at SMU 56/57 are well within the uncertainty of the models, given the acceptable threshold for model performance developed in cooperation with the FRG (*Model Evaluation Workgroup Technical Memorandum 1: Model Evaluation Metrics*). The acceptable level of performance defined in Technical Memorandum 1 is ±30 percent of observed concentrations.

Master Comment 5.6

The commenter expressed a desire that sediment handling processes should minimize volatilization of PCBs and the Agencies should maximize the use of innovative, safe, and permanent treatment technologies.

Response

Regarding the commenter's position on volatilization of PCBs, the FRG undertook an extensive air monitoring program at the SMU 56/57 dredging project. Ambient air PCB concentrations recorded on and near the site were less than 80 percent of the conservative lifetime risk level while off-site risks never exceeded 4 percent. Whereas PCB volatilization during remediation of the most highly contaminated sediment in the Lower Fox River did not exceed unacceptable levels, WDNR and EPA do not consider volatilization to be a significant issue. However, losses from all pathways will be further evaluated and minimization strategies incorporated into the final remedial design.

Regarding the preference for permanent treatment technologies, comment noted.

5.1.3 Post-Dredging Residual Sediment Concentrations

Master Comment 5.7

Commenters stated that evidence from previous environmental dredging projects indicates that achieving an average SWAC sediment PCB concentration of less than 1 ppm is not attainable. They cite environmental dredging projects that they contend show post-remedial concentrations ranging from 2 to 16 ppm. They maintain that the record of environmental dredging at achieving remedial goals has been poor, and that no large-scale dredging project has ever been able to leave behind an average SWAC as low as 1 ppm.

Response

WDNR and EPA disagree with this statement and believe that with a carefully designed and executed remedial action, the overall goal of reducing the concentration of PCBs to levels below 1 ppm is achievable.

As documented in Appendix B of the FS, the *Sediment Technologies Memorandum*, the environmental dredging projects listed by the commenters as evidence of dredging ineffectiveness were in fact very effective if examined in light of the project goals. As stated in Section 5.1.1 above, imposing numeric "risk reduction" criteria on projects that were designed to remove mass is misleading. In the opinion of WDNR and EPA, these projects were successful and the lessons learned from those cited projects will be carried forward into the remedial design.

The *Sediment Technologies Memorandum* project review highlighted the fact that the success of a removal operation and residual contamination depends upon a number of factors. Several of the important factors that will be germane to the final remedial design on the Lower Fox River include:

- An experienced dredging design consultant;
- Early identification of required approvals/permits, and ability to comply with them;
- Adequate baseline monitoring to verify achievement;
- Verification sampling before demobilization from the Site;
- Long-term monitoring in place or considered;
- Physical constraints anticipated;

- Adequate physical characterization of impacted sediments including design level informational studies;
- Contingency plan for evaluating exceedances during dredging;
- Selection of equipment compatible with Site conditions and the constraints of the project;
- Type and depth of materials that underlie the dredging horizon;
- Average level of contamination above the dredging horizon prior to dredging;
- Depth of sediment to be removed; and
- Ultimate cleanup goal of the project.

Where these elements have been incorporated into the remedial design, those projects have successfully met their goals of either mass removal and/or risk reduction.

Several of the remedial dredging projects described by the commenters and then listed in Table 6 of their response (FRG Volume 1, p. 223) involved sites where contaminated sediments were underlain by hard substrate. These are discussed in detail in the white paper prepared for the Hudson River Responsiveness Summary entitled *Post-Dredging PCB Residuals*, White Paper 312663. WDNR and EPA concur with the findings of that document. Further, the Agencies note that site-specific conditions prevented over-cutting of contaminated materials, a strategy that could have led to significantly lower PCB residuals. Comparable conditions are expected to be encountered in some areas targeted for active remediation by WDNR. Within OUs 1, 3, and 4 of the Lower Fox River, the targeted fine-grained sediments are generally underlain by: (1) older fine-grained sediments, thus permitting an over-cut to be taken with the goal of leaving relatively clean sediments exposed; or (2) hard clay substrate that could be over-cut.

Based on WDNR's review of the sediment residuals from case study projects, it is apparent that sites with higher initial PCB concentrations yielded higher PCB residuals after dredging than did sites with relatively lower PCB levels. In this regard, the Lower Fox River is at the lower end of the PCB contamination spectrum (in terms of sediment PCB concentration). For the Lower Fox River, a targeted residual of 1 ppm PCBs represents a reduction of 96 to 98 percent from pre-dredge sediment concentrations.

Master Comment 5.8

Some commenters argued that dredging cannot reliably and consistently achieve the 1 ppm cleanup objective that WDNR and EPA have set for the Lower Fox River. They argue that the results of the demonstration projects on the Lower Fox River itself (Deposit N and SMU 56/57) demonstrated that none of these projects achieved a site-wide post-dredging average surface sediment concentration as low as 1 ppm.

Response

WDNR and EPA do not agree that the results of the demonstration projects point to an inability to achieve the environmental benefits outlined in the Proposed Plan. The demonstration projects had different remedial goals and successfully achieved those goals. The aims, goals, and the outcome of the demonstration projects, germane to answering this comment, are discussed below.

Deposit N Demonstration Project

The Deposit N demonstration project is discussed at length in the *Sediment Technologies Memorandum*, with complete reports available at WDNR's website: http://www.dnr.state.wi.us/org/water/wm/lowerfox/demoproj.html.

At Deposit N, the target goal of the dredging project was to achieve mass removal of PCB-contaminated sediment down to the design elevation and to assess the protectiveness of environmental dredging in removing PCB contamination. The project objective was to use the information gained to assess appropriate remedial technologies, effectiveness, and implementation of the selected technology and costs for a large-scale remedy of the Lower Fox River. Residual surface sediment concentration was not a performance-based criteria endpoint for the project. The commenter's contention that pre- and post-sediment sampling was conducted to document the effectiveness of dredging in "reducing the availability of PCBs for uptake to the food web" (FRG Volume 1, p. 218) is factually incorrect. Dredging occurred to a design depth of 6 inches above bedrock to achieve mass removal. A total of 106 pounds was successfully removed from Deposit N (Foth and Van Dyke, 2000).

WDNR and EPA also believe that the conclusion offered by the independent review conducted by the Fox River Remediation Advisory Team (FRRAT) (FRRAT, 1999) for Deposit N supports the Proposed Plan remedial design and cleanup goals. The FRRAT report notes that sediments from the deposit, representing 96 percent of the PCBs and 87 percent of the mercury were removed from the portion dredged (the western lobe). The concentrations of PCBs and mercury in treated waters discharged back to the Lower Fox River were less than 0.01 percent of the concentrations in the sediment slurry transported to the shoreside treatment site. Based on the results of Phase I activities, the advisory team reached the following conclusions regarding the effectiveness of dredging at Deposit N:

- Environmental dredging is an effective mechanism for removal of contaminated sediments from Deposit N in the Lower Fox River;
- A mass balance approach is the most scientifically defensible measure for assessing the effectiveness of a dredging operation;
- Shoreside processing was an effective means of concentrating and permanently removing contaminated sediments from the River;
- Dredging on the Lower Fox River should be conducted during a period when monitoring is sufficient to determine losses from the activity;
- Common techniques such as measurement of TSS and turbidity do not adequately describe riverine transport of PCBs;
- Prior to dredging, Deposit N represented an active source of PCBs to the Lower Fox River and was not “naturally” capping with clean sediments;
- The demonstration project at Deposit N provided information important for future shoreside processing design;
- The demonstration project at Deposit N provided information important for water column sampling designs; and
- The mass balance framework is a feasible and useful approach for future dredging activities.

SMU 56/57

The SMU 56/57 demonstration project is discussed in the *Sediment Technologies Memorandum*, with complete reports available at WDNR’s website: http://www.dnr.state.wi.us/org/water/wm/lowerfox/demoproj.html. This includes reports on the removal and disposal portions of the project, as well as studies conducted by the USGS that evaluate PCB resuspension issues during the project (see also Section 5.1.2), as well as a report on the monitoring of PCB volatilization to air during the removal projects (see also Sections 5.1.4 and 8.4.1 of this RS).

The objectives for the SMU 56/57 project called for the removal of a specific volume of contaminated sediment from an area established in the original 1999 pilot project. The objectives of the work in 2000 called for the area to be dredged to a specific elevation. The remaining sediment was then sampled. Areas with PCB concentrations less than 1 ppm were considered to be completed and needed no further work. Areas with PCB concentrations between 1 and 10 ppm were to be covered with at least a 6-inch layer of sand. If confirmation sampling showed levels above 10 ppm, the dredging was to continue until the PCB concentration in the surface sediment was below 10 ppm.

Pre-removal, samples collected at the site showed concentrations of up to 710 ppm within SMU 56/57. After the two seasons of operations (under different construction firms), all the cleanup objectives were met for this project. Confirmation samples taken from the site ranged from "non-detect" to 9.5 ppm. Eleven out of 28 samples (about 40 percent) were less than 1 ppm and 24 of the 28 samples (86 percent) were below 4 ppm. Since this project was classified as an emergency response action, the cleanup objectives were specific for this project, and are not indicative of what the objectives would be for a cleanup of the entire River. Over the 2 years the project was operational, 2,111 pounds of PCBs were removed from the River.

References

Foth and Van Dyke, 2000. *Summary Report Fox River Deposit N*. Prepared for the Wisconsin Department of Administration, Wisconsin Department of Natural Resources by Foth and Van Dyke, Green Bay, Wisconsin. April.

FRRAT, 1999. *Evaluation of the Effectiveness of Remediation Dredging: The Fox River Deposit N Demonstration Project November 1998–January 1999*. Fox River Remediation Advisory Team, Madison, Wisconsin. Website: http://www.dnr.state.wi.us/org/water/wm/lowerfox/sediment/depositnevalu.htm.

Master Comment 5.9

Commenters listed the Manistique River and Harbor (Manistique, Michigan) removal action conducted on behalf of the EPA as another example of the inability of dredging to reduce surface sediment concentrations, and that the RAL of 1 ppm for the Lower Fox River is unachievable. They further contend that dredging increased PCB surficial sediment concentrations and bioavailability at that site. Furthermore, they maintain that the average surface sediment PCB concentrations in areas that were not dredged (in Manistique Harbor) have decreased since 1993. In areas that were dredged, exposing underlying concentrations, average surface sediment PCB levels have increased.

Response

Manistique Harbor is an example of a site where on-site conditions have presented considerable challenges to the removal operation. As discussed in the *Sediment Technologies Memorandum*, the many challenges at this project have contributed to many of the "lessons learned" that are being now applied for planning at other projects, including the Hudson River as well as the Lower Fox River. Implementation of the dredging project was made more difficult by an incomplete site characterization prior to starting dredging activities. Design components were constructed from sediment cores that supposedly hit refusal when the cores actually hit buried wood and debris, and not bedrock. The dredging equipment was selected based on this premise. The difficulty of dredging wood, sawdust, rock, and gravel was not fully considered when estimating the cleanup effort. Due to site conditions, most dredged areas were not initially cleaned up to meet target objectives and subsequently needed to be re-dredged, sometimes multiple times. Thus 100 percent removal of contaminated sediments was not possible by an over-dredging technique, and areas had to be re-dredged multiple times over multiple years.

The "lessons learned" from the Manistique project as well as results on the Deposit N and SMU 56/57 demonstration projects have been considered and incorporated in the Lower Fox River and Green Bay Proposed Plan and ROD. These "lessons" inform us that, among other concerns, shallow bedrock overlain with contaminated sediments and debris presents challenges that require careful planning and design, along with experienced contractors. Without these factors considered, it may be very difficult to achieve risk reduction goals. While shallow bedrock underlying contaminated sediments is not a concern for OU 1, it is a concern in OU 2. Therefore, implementability and effectiveness are considerations incorporated into the decision to not dredge in OU 2, instead relying on MNR as the remedial alternative for that OU.

Master Comment 5.10

Commenters stated that the residual PCB concentrations after dredging would exceed the RAL of 1 ppm. They argue that the Proposed Plan projects that removal would result in a post-remediation SWAC of 0.19, 0.26, and 0.16 ppm in OUs 1, 3, and 4, respectively, and that the Proposed Plan assumes success in reaching a low-concentration "bottom," along with no recontamination problems from sediment resuspension during dredging.

Response

WDNR and EPA believe that the residual concentrations assumed in the Feasibility Study for dredge areas are a reasonable and conservative assumption. The *Sediment Technologies Memorandum* (Appendix B of the

FS) showed an average 97 percent concentration reduction for five dredging projects. Additionally, the Hudson River Responsiveness Summary White Paper (*Post-Dredging PCB Residuals* [ID 312663]) showed dredging residual concentrations 96 to 98 percent for nine projects evaluated. Additionally, the Lower Fox River SMU 56/57 dredging project had a 96 percent concentration reduction; pre-dredging PCB concentrations were greater than 50 ppm and post-dredging concentrations were 2 ppm. The Lower Fox River dredging project would use similar equipment and techniques as these projects for comparable site conditions. Thus, WDNR and EPA believe that an estimate for residual PCB concentrations of less than 1 ppm is reasonable and, if anything, conservative.

Master Comment 5.11

Commenters stated that the Consent Order for SMU 56/57 required that the residual surface sediment PCB concentration after dredging not exceed 10 ppm, and that a sand cap at least 6 inches thick be placed over areas where the residual surface sediment PCB concentration was greater than 1 ppm. They contend that since a sand cover was placed over the entire dredge area at SMU 56/57, although some of the dredged areas did not require a cap by the Consent Order, that this is another indication that post-dredge surface sediment concentrations will be greater than 1 ppm.

Response

WDNR and EPA strongly disagree with this comment, and submit that the commenters have misconstrued the intent of the placement of a sand cap over the entire area. As discussed in Master Comment 5.8, it is important to understand that pre-removal, samples collected at the site showed concentrations of up to 710 ppm at SMU 56/57, and that post-remedy confirmation samples taken from the site ranged from “non-detect” to 9.5 ppm. Eleven out of 28 samples (about 40 percent) were less than 1 ppm and 24 of the 28 samples (86 percent) were below 4 ppm.

Concerning the placement of the sand cap, WDNR and EPA gave the Fort James Corporation (now Georgia Pacific Corporation) a release from all future liabilities at SMU 56/57 where removal achieved final concentrations of less than 1 ppm, or where a sand cap was placed over PCB concentrations less than 10 ppm. Given the results of the post-dredging confirmation sampling, a sand cap over the entire area was not required. However, Fort James Corporation voluntarily chose to cover the entire dredged area with sand to delineate the area for which they obtained a release from WDNR and EPA for future possible remedial actions at that site.

Master Comment 5.12

Commenters stated the impacts of sediment removal must be correctly and fully assessed in the FS and that potential impacts of sediment plumes from dredging are well known. These impacts from the dredging process can result in the exposure of high PCB concentrations buried in the sediments directly to the water column and the dispersal of PCBs to other areas through resuspension.

Response

WDNR and EPA believe that the concerns raised by the commenter will be managed in a correctly designed and implemented remedial alternative. As documented in the response to Master Comment 5.10 above, the Agencies believe that the SWAC can be achieved for each OU, even though there will be instances where individual sample location concentrations will exceed the RAL.

The Agencies also believe it is important that the issue of residual risk be placed into context, and balanced with impacts associated with ongoing PCB releases to the water column and impacts to the aquatic biota. While much is made of the residual sediment concentrations, the fact remains that all parties evaluating the food web within the Lower Fox River agree that uptake, and hence exposure, comes from resuspended PCBs, not bedded sediments. The Lower Fox River is a pelagic-based food chain (WDNR, 2001; Exponent, 1999), and the uptake to fish, and subsequently humans and piscivorous wildlife, comes from the resuspended PCBs, not the bedded sediment PCBs. The Agencies note that the commenters point to the decrease of sediment concentrations at SMU 56/57 from as high as 710 ppm to an average of 2.2 ppm as a "failure" of dredging to achieve risk reduction goals. What is not discussed in the assessment is that the removal of over 2,000 pounds of PCBs from the River in one small area equates to over 10 years of export and exposure of PCBs into Green Bay. The net residual sediment concentrations contribute negligible quantities (and hence risks) to biota from either the WDNR or FRG food web models.

References

Exponent, 1999. *Model Evaluation Workgroup Technical Memorandum 7a: Analysis of Bioaccumulation in the Fox River*. Prepared for the Fox River Model Evaluation Workgroup by Exponent Bellevue, Washington. February.

WDNR, 2001. *Technical Memorandum 7c: Recommended Approach for a Food Web/Bioaccumulation Assessment of the Lower Fox River/Green Bay Ecosystem*. Wisconsin Department of Natural Resources, Madison, Wisconsin. January.

Master Comment 5.13

Commenters cite a 1991 USACE document stating that "no existing dredge type is capable of dredging a thin surficial layer of contaminated material without leaving behind a portion of that layer and/or mixing a portion of the surficial layer with underlying clean sediment." This quote is used to support their supposition that dredging requires considerable "over-dredging" to remove target deposits (laterally and vertically), and that residual concentrations below 1 ppm cannot be achieved.

Response

The commenter cites a 1991 USACE document, without acknowledging that technology has advanced, and that several USACE, EPA, and industry documents have been released that document the numerous technological advancements in removal options. This includes the following documents cited in the FS:

- *Assessment and Remediation of Contaminated Sediments (ARCS) Program, Remediation Guidance Document* (EPA, 1994);
- *Innovations in Dredging Technology: Equipment, Operations, and Management* (McLellan and Hopman, 2000);
- *Dredging, Remediation and Containment of Contaminated Sediments* (Demars et al., 1995); and
- *Advances in Dredging Contaminated Sediment: New Technologies and Experience Relevant to the Hudson River PCBs Site* (Cleland, 1997).

Case studies described in the *Sediment Technologies Memorandum* (Appendix B of the FS) have typically shown that 6 inches of vertical "over-dredge," when feasible, have met post-verification surface sediment concentration goals after remediation. Newer and better equipment improves on the ability to remove thinner sediment layers with less fallback. For example, in the more recent USACE-sponsored demonstration action in New Bedford Harbor, the mechanical bucket recently developed by Bean Environmental Dredging, Ltd. was able to extract 90 percent of the mass at the test site in a single pass. Surface sediment concentrations (pre-removal) were 2,600 ppm, whereas after a single pass they were reduced to 29 ppm.

The objective of vertical over-dredging is to ensure that the bulk of impacted sediments have been removed with minimal residuals left in place. The objective of lateral over-dredge beyond the dredge footprint is to ensure slope stability during removal operations and will be considered during the design phase. In areas where over-dredging is not feasible, post-verification metrics other than discrete surface sediment concentrations (SWACs) should be considered in order to quantitatively determine potential risk reduction benefits. Natural attenuation is governed by "over-dredging" but by different processes such as sediment burial, dechlorination, and biodegradation.

References

Cleland, J., 1997. *Advances in Dredging Contaminated Sediment: New Technologies and Experience Relevant to the Hudson River PCBs Site*. Scenic Hudson, Inc., Poughkeepsie, New York.

EPA, 1994a. *Assessment and Remediation of Contaminated Sediments (ARCS) Program, Remediation Guidance Document*. EPA 905-B94-002. United States Environmental Protection Agency, Great Lakes National Program Office.

Demars, K. R., G. N. Richardson, R. Yong, and R. Chaney, 1995. *Dredging, Remediation and Containment of Contaminated Sediments*. American Society of Testing Materials Publication STP 1293.

McLellan and Hopman, 2000. *Innovations in Dredging Technology: Equipment, Operations, and Management*. ERDC-TR-DOER-5. Prepared for the United States Army Corps of Engineers, Dredging Operations and Environmental Research Program. April 5.

5.2 *In-Situ* Sediment Caps

Master Comment 5.14

Some commenters noted that the draft FS and Proposed Plan evaluated only a single cap design. They indicated that the single design was not appropriate, and suggested that the FS should have designed the caps (e.g., design thickness, materials, armoring) following procedures defined in the EPA and USACE guidance documents (Palermo et al., 1998a, 1998b).

Response

In-situ capping (ISC) was identified within the Draft FS for the Lower Fox River and Green Bay as an appropriate and applicable remedy for consideration within the Lower Fox River and Green Bay. Illustrative designs for ISCs were described in the FS and incorporated into alternatives, which were incorporated into the FS and evaluated for each reach OU of the River based upon site-specific physical considerations. ISCs were then further evaluated using CERCLA criteria related to short- and long-term effectiveness, implementability, reduction in toxicity, mobility, volume through treatment, and cost.

WDNR and EPA agree that for final design, any ISC should be designed for the specific site and location for which it is intended. The Agencies do disagree, however, that it is necessary or needed for the purpose of a feasibility study. As articulated in *White Paper No. 6B – In-Situ Capping as a Remedy Component for the Lower Fox River* (Palermo et al., 2002), the necessary minimal engineering design evaluations include the following:

- Modeling to assess consolidation;
- The potential for advective and diffusive flux from either consolidation or from groundwater intrusion;
- An evaluation of local capping material and iterative design testing to insure that the cap design is effective at chemical isolation;
- An evaluation of the 100-year shear-stress forces at the sediment/water interface to effectively evaluate physical stability and design and armoring layer as necessary; and
- An evaluation of whether the placement of the cap would result in an alteration to the flood channel, as required by Wisconsin state law. These are only some of the technical considerations, and do not include the regulatory, public acceptance, land use, and long-term fiduciary responsibility issues.

In responding to comments on the Draft FS and Proposed Plan, WDNR and EPA requested that Dr. Michael Palermo review the FS design and alternative capping proposals that were submitted as part of the public comment. *White Paper No. 6B – In-Situ Capping as a Remedy Component for the Lower Fox River* provides a detailed description of the technical, engineering, construction, monitoring, and regulatory/institutional requirements for capping on the Lower Fox River. That white paper, along with Dr. Palermo's comments to the FS and on the submitted capping alternatives (*White Paper No. 6A – Comments on the API Panel Report*) form the basis of the responses below.

The FS evaluated which minimum physical designs had been successful at other capping sites throughout the world, relative to conditions on the Lower Fox River to develop an adequate representative cap design for the purposes of the FS. These projects were provided in Appendix D to the FS, and are updated in Table 3 of *White Paper No. 6B – In-Situ Capping as a Remedy Component for the Lower Fox River*. Professional judgment was exercised by the staff working on the FS, who have been involved in the design, construction, and/or monitoring of several capping sites. Given that there have been no demonstrated long-term monitoring on effective caps in a riverine environment, the representative design option required some conservatism. In order to effectively evaluate a capping alternative in a riverine environment, an engineering decision was made to utilize a design that had a demonstrated environmental track record.

Successfully applied caps with track records were recorded in Appendix B of the FS. That table has been updated in *White Paper No. 6B – In-Situ Capping as a Remedy Component for the Lower Fox River*. As documented in Section 7.1 of the FS, a 20-inch sand cap overlain by 12 inches of graded armor stone was selected as the representative process option for all locations. The FS went on to note, however, that several thinner or thicker cap designs may be applicable during final design and implementation. As a representative option, the Agencies consider the design to be adequate.

References

Palermo, M. R., T. Thompson, and F. Swed, 2002. *White Paper No. 6B – In-Situ Capping as a Remedy Component for the Lower Fox River*. In: *Responsiveness Summary – Lower Fox River and Green Bay, Wisconsin, Remedial Investigation and Feasibility Study*. Prepared for Wisconsin Department of Natural Resources and the United States Environmental Protection Agency by United States Army Corps of Engineers. December.

Palermo, M. R., J. E. Clausner, M. P. Rollings, G. L. Williams, T. E. Myers, T. J. Fredette, and R. E. Randall, 1998a. *Guidance for Subaqueous Dredged Material Capping. Technical Report*. DOER-1. United States Army Corps of Engineers, Waterways Experiment Station, Vicksburg, Mississippi. Website: http://www.wes.army.mil/el/dots/doer/pdf/doer-1.pdf.

Palermo, M. R., J. Miller, S. Maynord, and D. Reible, 1998b. *Assessment and Remediation of Contaminated Sediments (ARCS) Program Guidance for In-Situ Subaqueous Capping of Contaminated Sediments*. EPA 905/B-96/004. Prepared for the Great Lakes National Program Office, United States Environmental Protection Agency, Chicago, Illinois. Website: http://www.epa.gov/glnpo/sediment/iscmain.

Master Comment 5.15

Several commenters argued that an engineered cap, which was less extensive than the single option considered in the FS, should have been evaluated. They further stated that the Draft FS rules out thin-layer capping as an option on the grounds that River velocities are too high, despite Lower Fox River stream velocity data presented in the Draft FS itself showing that even 100-year flows in OUs 1 and 3 are within the range of USACE guidance for thin layer capping.

Response

There appears to be some confusion of the concept and use of the term "thin-layer" cap as used by sediment capping engineers, and what the commenters are suggesting here. As discussed in the FS, a thin-layer capping involves the placement of a thin (1- to 3-inch) layer of clean sediments that is subsequently mixed with the underlying contaminated sediments to achieve acceptable chemical of concern (COC) concentrations and/or enhance the natural attenuation process. Mixing occurs naturally as a result of benthic organism activity (bioturbation). This approach is best suited to situations involving contaminants that naturally attenuate over time, or where contaminant concentrations are sufficiently low that "dilution" is the preferred alternative. Examples of where this has been used include the West Eagle Harbor OU in Washington, and the Ward Cove, Alaska Superfund Site (see *White Paper No. 6B – In-Situ Capping as a Remedy Component for the Lower Fox River* for a discussion). Thin-layer capping, in this sense, has not been considered an acceptable alternative for the Lower Fox River. The FS does discuss thin-layer capping.

As discussed in the response to Master Comment 5.14, the cap design thickness used in each area will be a site-specific engineering determination made during the remedial design phase.

Master Comment 5.16

Commenters stated the Draft FS and Proposed Plan ignore information showing that capping is a feasible approach for many areas of the River and that the FS only considered capping in River areas with the slowest currents. This is contracted by the Appleton Paper, Inc. Panel (the "API Panel") conclusion that "a cap can be designed to be stable in almost any flow regime."

Response

This statement is not accurate. The FS considered capping a feasible alternative for all OUs on the River. As discussed in the response to Master Comment 5.14, proponents of capping cannot point to a single, successful capping alternative with a long-term environmental track record in a riverine environment. As such, the representative process design in the FS was conservatively based upon successful caps constructed elsewhere. Despite the commenter's critique concerning current limitations, the FS capping alternatives for OUs 1 and 3 cover greater areas than those proposed by the API Panel (see FS Figures 7-17 and 7-30 relative to API Panel Figures 7 and 8). This is not true for OU 4, where both WDNR and EPA believe that the capping would be subject to greater erosional forces. In all respects, the capping alternatives presented in the FS are more conservative by design than those offered by the API Panel. Specific comments to the API Panel design are addressed in Section 5.5.

Master Comment 5.17

Some commenters took issues with the cost basis proposed for the capping alternative in the FS. They maintained that capping costs were too high, and claimed that the FS determined that capping was not a feasible option.

Response

It is important to distinguish that capping was a remedy component within the FS that included dredging and natural attenuation (depending upon the action level evaluated). That capping would be a sole remedy of any reach is likely not to be practicable, given the physical, regulatory, and institutional constraints (Palermo, 2002). Within the aerial footprint defined by the remedial action level, capping areas were identified to the maximum extent practicable, based upon the physical constraints (e.g., navigational channel, TSCA materials, depth, etc.). Within the remedial action level footprint, those areas for which a cap was not feasible were then included in a removal action. Areas outside the footprint were considered to be naturally attenuating.

It is not clear what element of capping the commenters are criticizing. The components of the capping remedy are based upon availability of local materials, and are derived from the FS staff's direct experience with engineering and constructing caps. The removal and disposal elements of the alternative assume disposal at a local commercial landfill. The costs expressed in the Final FS have been checked and modified as necessary to reflect landfill and transportation costs. In addition, the capping construction and monitoring components in the FS are consistent with those identified for other projects in *White Paper No. 6B – In-Situ Capping as a Remedy Component for the Lower Fox River*.

Reference

Palermo, M. R., 2000. *White Paper No. 6A – Comments on the API Panel Report*. Prepared for Wisconsin Department of Natural Resources by Michael R. Palermo, Ph.D. December.

Master Comment 5.18

One commenter noted that an important consideration for any cap design is the potential for long-term diffusive and/or advective migration of dissolved PCBs into and through the capping material. The commenter further stated that the FS is unclear whether the potential for direct receptor contact with sediment-bound contaminants appears to have been ultimately considered when choosing sand as the principal cap material. It is suggested that the potential for transfer of dissolved PCBs (the commenter is referring to a uniquely bioturbation-driven mechanism for transfer of impacted pore water) should be considered and perhaps the cap augmented with some type of clay or other commercial product that might preclude advection and/or bioturbation

Response

Both bioturbation and the potential for advective and/or diffusive flux were considered when evaluating the representative cap design. As stated in the response to Master Comment 5.14, the representative design thickness was selected based upon successful long-term isolation of contaminants at other sites. As documented in *White Paper No. 6B – In-Situ Capping as a Remedy Component for the Lower Fox River*, a final engineered cap will need to have to consider availability of local materials, the potential for bioturbation of the cap, stability to erosion by hydrologic factors, advective and diffusive flux, as well as operational and institutional considerations. As for the issue of bioturbation, *White Paper No. 6A – Comments on the API Panel Report* notes that given the benthic infauna in the River, bioturbation will likely be limited to only a few millimeters.

Master Comment 5.19

Some commenters felt that the technical restrictions placed upon cap locations within the FS were "arbitrary and unjustified." These issues included water depths, limits to ice scour, navigation channels, flow conditions, etc. The commenters felt that these restrictions "eliminated" the use of capping on the Lower Fox River.

Response

An ISC must meet two basic conditions in order to be an effective remedial alternative: (1) it must be capable of isolating contaminants in perpetuity, and (2) it must be internally/externally stable against erosion. The physical restrictions identified within the FS were conservatively selected in order to ensure that any proposed alternative met these two basic needs. They are neither arbitrary nor unjustified. *White Paper No. 6B – In-Situ Capping as a Remedy Component for the Lower Fox River* provides a more detailed evaluation of these physical conditions, along with recommendations for their applications.

With regards to identification of capping areas within the River, large potential areas were identified in the FS as potentially suitable for capping. When compared at the same RAL (0.5 ppm), the FS capping alternatives for OUs 1 and 3 cover the same areas and more than those proposed by the API Panel (see FS Figures 7-17 and 7-30 relative to API Panel Figures 7 and 8). This is not true for OU 4, where both WDNR and EPA believe that the capping would be subject to greater erosional forces. Thus, while the design may be considered conservative, the application areas are essentially the same as those offered by the API Panel in the two southern OUs. Specific comments to the API Panel design are addressed in Section 5.5.

Master Comment 5.20

Some commenters argued that the potential risk of localized cap failure can be minimized with proper cap design, installation, monitoring, maintenance, and repair. They further argued that there should be no restrictions to capping sediments with PCBs exceeding the TSCA criterion of 50 ppm.

Response

WDNR and EPA agree that a properly designed, constructed, and monitored cap can be an effective remedial alternative. Furthermore, the need for long-term operations and maintenance is agreed to by all parties. What is less clear are the fiduciary mechanisms necessary to ensure that the long-term operation and maintenance costs are fully covered. These and other institutional and regulatory requirements are discussed in more detail in the *White Paper No. 6B – In-Situ Capping as a Remedy Component for the Lower Fox River*.

The ability of an ISC to meet the requirements of TSCA has not been fully established. TSCA-level sediments are present only in limited areas of OUs 1, 3, and 4. Based on these considerations, the *White Paper No. 6B – In-Situ Capping as a Remedy Component for the Lower Fox River* states that no capping of TSCA-level sediments should be considered.

Master Comment 5.21

Commenters stated that land impacts regarding capping need to be included so that these impacts can be compared to the land impacts of dredging.

Response

Land use impacts are discussed in the FS and in ISC *White Paper No. 6B – In-Situ Capping as a Remedy Component for the Lower Fox River*. In general, impacts from staging areas for capping will be the same as for those of dredging. Land use impacts related to increased mining of quarry material for capping alternatives is beyond the scope of this FS.

Master Comment 5.22

Commenters noted that there is an inconsistency in the FS in that the FS requires 6 feet clearance on top of a 32-inch cap after previously stating that 3 feet is all that is necessary.

Response

This text inconsistency is noted and corrected in the Final FS. Capping areas in less than 6 feet of water were not considered for capping in order to ensure that water depths no less than 3 feet were created by cap installation. The only exception to this was in federal navigation channels. However, an important clarification in the *White Paper No. 6B – In-Situ Capping as a Remedy Component for the Lower Fox River* is that long-term Great Lakes level changes (from +5 to –1 feet) should be accounted for in designing for these restrictions for OU 4. Considering these restrictions, no cap should be constructed with a surface above -3 feet chart datum in OUs 1 and 3, and above -4 feet chart datum in OU 4. Removal may therefore be required prior to ISC placement in shallow-water areas.

Master Comment 5.23

Commenters stated that the draft FS and Proposed Plan eliminate capping as a remedial option in any area of the River with a depth of less than 3 feet. However, the Draft FS errs by assuming that navigation takes place throughout the entire River, both in the navigation channel and out of the channel, in the middle of the River, and along the banks.

Response

A federally authorized navigation channel system exists from the mouth of the River up to the Menasha Channel. Federal law prohibits construction within a federal navigation channel, unless congressional authorization is given. In OU 4, the USACE maintains an 18-foot-wide deep commercial channel in OU 4. For OUs 1 and 3, the USACE no longer maintains the authorized channel depth and there is no longer commercial traffic in these reaches. However, the WDNR has indicated that there will be future demand to maintain a 6-foot-deep channel in OUs 1 and 3 for recreational use. At a minimum, a Lake Bed Grant would be required to construct within the state-owned navigation channel.

Master Comment 5.24

The Draft FS limited capping to areas of the River in which the average current speed is less than 0.15 feet per second (ft/s) and the maximum (100-year flood) current speed is no greater than 0.7 ft/s. The FS did not provide justification for this criterion.

Response

The current criteria listed in the FS were derived using the bottom sheer-stress estimations as defined in *Technical Memorandum 5c*, *Evaluation of the Hydrodynamics in the Lower Fox River between Lake Winnebago and*

De Pere, Wisconsin (TM5c) (HydroQual, 2000). These velocities were tied directly to erosion/resuspension in the Lower Fox River.

Reference

HydroQual, 2000. *Technical Memorandum 5C: Evaluation of the Hydrodynamics in the Lower Fox River Between Lake Winnebago and De Pere, Wisconsin*. Prepared for Limno-Tech, Inc. by HydroQual, Inc., Mahwah, New Jersey. December.

Master Comment 5.25

Commenters noted the Proposed Plan cites as a "significant factor" in its selection of dredging the assertion that "the surface of any cap placed downstream of residual contamination may become recontaminated following placement, which can therefore reduce risk reduction by the cap." This is wholly as dredged areas are subject to same risks of recontamination as capped areas.

Response

The Agencies agree that downstream recontamination can occur from both cap placement over contaminated dredging and removal of contaminated sediment via dredging. The reason for indicating this in the Proposed Plan was to inform the public that a cap does not necessarily leave behind a sediment surface environment that is free of contamination as has been suggested. Recognizing that upstream resuspension and the potential for recontamination from either capping or dredging is another reason for addressing the upstream OUs first as is done in the ROD.

Master Comment 5.26

One commenter argued that dredging does not improve on natural attenuation and that capping is the only generalized remedial alternative that can offer any environmental improvements.

Response

WDNR and EPA do not agree with this statement. Both dredging and capping can provide similar levels of short-term protection when properly implemented. These two remedial options can be very different in terms of permanence and long-term protection. When properly designed and implemented, the Agencies believe either of these remedial options can provide significant improvement over natural attenuation in certain areas of the Lower Fox River.

Master Comment 5.27

Some commenters expressed concern that capping in shallow-water areas may affect water depth, flood-carrying capacity, habitat function, and recreational activities, and may be affected by ice scour and wave action.

Response

WDNR and EPA agree that capping in shallow areas would create concerns regarding stability, River use impacts, possible increases of risk, and achieving project RAOs. Operationally, no cap will be built that raises the mudline elevation to within 3 feet of the water surface. Baseline data, collected before remedial activities begin, will be compared to post-remedy flooding effects and habitat concerns. Thus, armoring was not evaluated, as it would be counterproductive to many of these monitoring data. If necessary, the remedy process may be subject to modification to meet the RAOs.

5.3 Monitored Natural Recovery

5.3.1 MNR as an Alternative

Master Comment 5.28

Commenters noted that data presented in the Proposed Plan (p. 18) suggest that MNR will not work; below a concentration of 30 ppm PCB degradation does not occur and the majority of sediment concentrations in the River and the Bay are less than 30 ppm. Also, fish concentrations have not fallen for the last 12 years (p. 12, Figure 9) so how does this demonstrate that MNR will work?

Response

WDNR and EPA stand by the decision to select MNR for OU 2. This decision is based on risk reduction and is discussed in Section 9.7 of the Proposed Plan. In summary, this section states that that OU 2 contains a relatively small amount of PCBs and contaminated sediments. Furthermore, of the 22 sediment deposits that are within OUs 2 and 4 contain 58 percent of the estimated PCB mass. Two deposits (N and O) have been remediated as part of the demonstration project and a second deposit (DD) is being targeted for potential remediation as part of the ROD.

Furthermore, the reference to 30 ppm PCBs on page 18 of the Proposed Plan refers to the lower level in which natural degradation of PCBs will occur. Degradation is only one of several components of natural recovery. Other natural recovery processes include burial as well as dispersion of material within the River. Concerning Figure 9 on page 12 of the Proposed Plan, while this does demonstrate a trend in fish tissue concentrations, it is specific to Little Lake Butte des Morts, not the River and Bay.

Master Comment 5.29

A comment by the API Panel stated that natural recovery cannot serve as a feasible primary or singular remedy and that sedimentation is too slow to isolate high concentrations in a short time.

Response

WDNR and EPA agree with the API Panel on this statement. Their decision to proceed with active remediation was based on risk reduction and time necessary to reduce or eliminate consumption advisories for fish. WDNR and EPA concur that the processes involved in natural recovery; degradation, dispersion, and burial, are not amenable to an effective and expeditious remediation of the Lower Fox River. Modeling of the River shows no action and natural recovery would result in a prolonged time period to reduce health risks when compared to active remediation.

Master Comment 5.30

Commenters stated that the MNR component of the Proposed Plan relies too heavily on potentially ineffective fish consumption advisories and does not account for dam removal and/or maintenance.

Response

WDNR and EPA believe that the criteria established concerning the time necessary for the reduction in PCB concentrations in fish tissue are reasonable. Furthermore, while not all consumption advisories will be able to be removed once the remediation is complete, WDNR and EPA do expect that as time passes, the advisories will be removed or reduced based on computer modeling. WDNR and the PRPs will also continue to monitor fish for tissue concentration reduction. Fish consumption advisories are only effective if fish consumers are aware of the advice and choose to follow that advice. WDNR, in cooperation with the Wisconsin Division of Health, will revise the fish consumption advisories for the Lower Fox River and Green Bay according to the Great Lakes Task Force Protocol and continue to provide that information using a variety of methods (e.g., publications, news releases, Internet sites). In addition, these Agencies plan to continue educational efforts such as posting advisories at boat landings and providing literature on advisories in multiple languages.

WDNR did an evaluation of the dams on the Lower Fox River. The dams on the River are all inspected on a regular basis, have to undergo re-licensing every 20 years by FERC, and there are no plans to remove any of the dams at this time. This inspection and licensing program should avoid any catastrophic dam failure. Should a decision be made to remove a dam or should it become necessary, the water behind the dam would be gradually lowered. This may result in resuspension of sediment.

Master Comment 5.31

A commenter stated that natural attenuation and the alternative remedy are more protective than the Proposed Plan remedy and that, in fact, both natural attenuation and the alternative remedy are superior to the Proposed Plan remedy in terms of compliance with chemical-specific ARARs relating to water quality because they do not increase PCB water column concentrations, and location-specific ARARs.

Response

The WDNR and EPA do not agree with this opinion. The analyses provided in the RI/FS, the BLRA, and the Proposed Plan all point to significant benefits for active remediation in OUs 1, 3, and 4. Even the expert panel hired by API indicated that they believed that active remediation is needed in the Lower Fox River. WDNR and EPA believe the recommended plan will result in reduction, in the long run, of water column concentrations. This was discussed in Table 9 of the Proposed Plan and in the FS.

Master Comment 5.32

A commenter contended that natural recovery is occurring in Little Lake Butte des Morts, except in two hot spot areas – Deposit A and the southwestern portion of Deposit POG.

Response

WDNR and EPA disagree with this statement. As stated in Master Comment 2.14, recent sampling completed in OU 1 showed that sediment concentrations are higher at both Deposit A and Deposit POG than have ever been previously measured. In addition, all samples collected in Deposit E showed that sediment PCBs still exceed the RAL of 1 ppm.

Master Comment 5.33

Some commenters felt that natural attenuation would work better than the Proposed Plan's dredging remedy to protect the Lower Fox River's environment.

Response

WDNR and EPA assessed numerous technologies for remediation of the Lower Fox River and Green Bay. This evaluation included no action, MNR, capping in combination with other technologies, dredging, and others. Following the evaluation of technologies, WDNR and EPA considered the effectiveness of the technologies at reducing risk at various action levels along with cost and implementability. Using the tools in the RI/FS and BLRA, WDNR and EPA's analysis demonstrates that natural recovery will have limited effectiveness to the area defined as OU 2. In the other OUs, there is significant benefit associated with active dredging of contaminated sediments to reduce surface concentrations. Evaluations completed by WDNR and EPA indicated that natural attenuation or natural recovery do not provide sufficient protection and are significantly less protective than the dredging remedy presented in the ROD. Evidence supporting this is:

- Bathymetric data showing continued re-exposure of contaminants;
- Many areas in OU 1 where the highest PCB concentrations are in the surficial sediments;
- Current risks are significantly above those considered acceptable by WDNR or EPA, and a weight-of-evidence approach informs the Agencies that any recovery would be relatively much longer than it would take for active removal (i.e., dredging);
- Dredging has been demonstrated to reduce contaminant concentrations and remove large amounts of contaminants;
- Contaminants that are removed will be disposed of in landfills with a design that has a well-demonstrated effectiveness for containment; and
- Dredging does not release significant quantities of contaminated sediments.

Master Comment 5.34

Commenters stated that in none of the comparisons does the proposed dredging remedy offer any significant benefit over natural attenuation, and in all of the comparisons, the proposed remedy actually hinders the natural attenuation of Green Bay by causing more PCBs to be exported to Green Bay beyond what would be expected under natural attenuation. These comparisons demonstrate that the selection of the proposed remedy would be arbitrary and capricious.

Response

WDNR and EPA disagree. Dredging offers several significant benefits over natural attenuation including a shortened time period in which PCB levels in the River will return to acceptable levels, and greater protection of fish and other aquatic life in the River by reducing their exposure to PCBs.

Natural processes would take more than 100 years for recovery, whereas a 1 ppm dredging remedy would remove fish consumption advisories in an estimated 20 years.

Master Comment 5.35

Commenters stated that monitored natural attenuation was rejected as a river-wide remedy without support from any actual data that it will take too long and is not reliable or permanent because of the potential for scour generally, and/or due to catastrophic flood.

Response

WDNR and EPA disagree with this statement, which incorrectly states natural attenuation is as effective as the remedy selected. Active remediation is more effective in protecting human health and the environment and it will more quickly reduce PCB transport to the Bay. This is pointed out in the comparative analysis of alternatives in Section 10 of the FS and is discussed in the ROD.

Master Comment 5.36

Commenters stated that only in localized areas over relatively short periods of time would the proposed remedy provide any reduction in sediment SWAC compared to natural attenuation. In OU 4, the proposed remedy would actually retard the reduction in SWAC over time that natural attenuation provides.

Response

WDNR and EPA disagree. Active remediation offers significant benefits over natural attenuation including a shortened time period in which PCB levels in the River will return to acceptable levels, and greater protection of fish and other aquatic life in the River by reducing their exposure to PCBs. Modeling projections suggest natural recovery would take more than 100 years for recovery, whereas a 1 ppm dredging remedy would remove fish consumption advisories in an estimated 20 years.

The Agencies recognize that immediately following the end of dredging operations, it is possible that patinas (thin residual layers) of more highly PCB-contaminated sediments may exist at the sediment-water interface. Such patinas were not explicitly included in the site-specific chemical transport and bioaccumulation models developed for the RI/FS. This model design factor was based on consideration of the ability of dredging technologies to achieve low residual PCB concentrations and the rapid rate at which conditions at the sediment-water interface are expected to change following dredging. As monitored following the first phase of the SMU 56/57 demonstration project in 1999, PCB concentrations in portions of the dredged area where post-dredging bed elevation meet the target elevations were approximately equal to PCB concentrations initially present at that sediment depth. This indicates that low residual PCB levels can be achieved by careful control of dredging to ensure sediments are removed with minimum disturbance to a depth required to achieve a desired residual. In addition, dredging alters the sediment transport regime of the dredged area. As a result, conditions near the sediment-water interface can change rapidly following dredging. Post-dredging monitoring of the SMU 56/57 site showed that rapid changes in the sediment-water interface occurred and that conditions a few months following dredging did not resemble conditions immediately following dredging. Based on these considerations, the effect of PCBs potentially present in post-dredge patina layers was considered negligible.

5.4 Remedy Selection

Master Comment 5.37

One commenter stated that the ROD should specify hydraulic suction dredging as the default sediment removal technology because:

1) Hydraulic dredging produces the lowest levels of sediment resuspension;

2) Hydraulic dredging can be engineered to minimize volatilization;

3) Hydraulic dredging works faster than mechanical dredging; and

4) The ability to pipe sediment slurry as far as 10 miles can reduce equipment traffic on the River and eliminate heavy truck traffic on regional roadways.

Response

Hydraulic dredging can be effectively used to control sediment resuspension, engineered to minimize volatilization, and connect to a sediment slurry pipeline to minimize equipment traffic. Recent technical advancements in mechanical dredges have led to greater precision in removing and limiting the release of excavated sediments, thereby minimizing sediment resuspension. Due to the unique characteristics presented by the River (bathymetry) and community (upland space for staging areas and processing areas), WDNR and EPA considered using both hydraulic and mechanical dredging technologies in the FS to effectively remove PCB-contaminated sediments from the Lower Fox River. These were both retained and either technology is allowed under "dredging" in the remedy described for OU 1. Both dredging technologies have been demonstrated to be effective for reduction of risks and for minimizing resuspension during dredging. However, it should be noted that appropriate design and competent operation are required to successfully implement either type of dredging.

Master Comment 5.38

Some commenters suggested that natural attenuation will achieve a SWAC in the River of 1 ppm within the same period of time as the WDNR's and EPA's proposed removal plan. This is presented as an argument for no action by some commenters. They maintain that a 1 ppm SWAC will be achieved in OU 1 in 14 years, OU 3 in 5 years, and OU 4 in 15 years. They express the opinion that natural attenuation will achieve the same aims as the proposed remedy, and question the WDNR's and EPA's selection of an active remedy.

Response

WDNR and EPA believe that the commenter misunderstands the risk reduction goals of the proposed remedy and confuses the RAL of 1 ppm with the term SWAC. Table 4 of the Proposed Plan shows that the active remediation will achieve SWACs of 0.19, 0.26, and 0.16 ppm, respectively, in the three OUs. The Alternative-specific Risk Assessment in the FS documents that, in fact, the sediment concentrations stated by the commenter are not likely to be met in 50 to 100 years, and thus the WDNR and EPA believe that active remediation is necessary.

Master Comment 5.39

Commenters argued that the proposed remedy relies on data from OU 4 to support the proposed remedy for OU 1. They opine that the remedial decision is based in part upon the relationship between sediment and fish PCB concentrations that is derived from OU 4 data, and argue that there are important differences in the uptake of PCBs by fish in the two reaches. The commenters further state that transport modeling conditions developed in OU 4 are imposed upon modeling in OU 1.

Response

The RI/FS and the accompanying BLRA considered each OU as a separate reach, each with its own set of COPCs, receptor species and food chain, human health exposure pathways, and remedial alternatives that were constructed with due consideration of local conditions. The commenter is in error to suggest that the remedy proposal for OU 1 is based upon conditions observed in OU 4.

Following the issuance of the Draft RI/FS in 1999, EPA's National Remedy Review Board recommended that the WDNR consider various levels of remediation for the Lower Fox River rather than selecting a single cleanup level based solely on the risk assessment. These RALs are explained in the FS and the Section 7.2 of the Proposed Plan. Section 9.6 of the Proposed Plan explains the basis for selecting the action level of 1 ppm for all three OUs. While the end result of the selection process was that the same action level was selected for all three OUs; the selection of the action level for each OU was independent of the other OUs.

Regarding the model representation of solids dynamic processes in wLFRM for Little Lake Butte des Morts, the results from the sediment transport model as documented in TM5d were used to parameterize the critical sediment resuspension events as shown in Table 3-7 in Appendix B of the FS. Results from TM2g were discussed and used qualitatively.

Master Comment 5.40

A commenter stated that closed-loop PCB destruction technologies should be used for higher concentration sediments (greater than 50 ppm PCBs), such as the Eco-Logic process described in the attached document, *Available Non-combustion POPs Destruction Technology*. Burning, melting, or incineration technologies must not be used due to the likely formation of dioxins and furans and the high potential for release of co-contaminants (mercury and lead).

Response

Data generated by the EPA Superfund Innovative Technology Evaluation program shows that vitrification (glass furnace technology [GFT]) does not generate dioxins and furans in the off gases from these technologies. Further, the WDNR and EPA do not agree with the commenter’s assertions that properly engineered and operated pollution control equipment does not reduce emissions of heavy metals to regulated levels.

Master Comment 5.41

A commenter stated that the proposed remedy presentation was vague and difficult to comment on and cites the Proposed Plan’s reference to an unnamed landfill and public right-of-way to run a pipeline from the Lower Fox River to the unnamed landfill.

Response

The level of detail provided in the RI/FS and supporting documents is consistent with Superfund guidance. The intent of providing this level of detail at this point is to determine whether the proposed remedial project for a site is feasible before developing the site-specific design and incurring the costs associated with design. When the site-specific remedy is undergoing design, more detailed information will be available.

Master Comment 5.42

The commenter provides several direct quotes from the NAS NRC, *A Risk-Management Strategy for PCB-Contaminated Sediments* National Academy Press (March 2001) to emphasize their concern that the FS recognizes that dredging remobilizes PCBs to the water column, but it fails to account for this in its analysis of the protectiveness or effectiveness of dredging.

Response

In other comments offered by these same authors, they acknowledged that the set of data from the monitoring of both pilot dredging projects represents the most comprehensive data set available. At SMU 56/57, the PCB loss approximated 2.2 percent of the mass removed. WDNR and EPA believe that this loss rate is the most applicable for the entire Lower Fox River, agreeing with the comment authors that: "Variations in site characteristics, the components of the remedy and their relevance to the lower Fox River, the method of sediment removal, the method and effectiveness of environmental controls, volume of sediment removed, and multiple contaminants of concern make direct comparisons between "successes" at other sites to the proposed project for the lower Fox River nearly impossible."

Therefore, applying the loss rates from this project that removed the most highly contaminated sediment in the entire Lower Fox River to the proposed remediation would equate to a total loss of less than 650 kg of PCBs (2.2 percent of 29,259 kg PCBs). If one were to accept the comment authors' additional claim that the annual PCB export from July 2000 to July 2001 was up to 106 kg of PCBs and that the rate of decline approximates a half-life of 9 years, over the next 20 years, more than 40 percent less PCBs would be released to Green Bay during active remediation (644 kg) than doing nothing (1,147 kg). Similarly, the target removal of 1,700 kg of PCBs from Little Lake Butte des Morts would potentially release less than 40 kg of PCBs, an amount roughly only double the amount one PRP suggested is contributed by sediments annually to the loading leaving Little Lake Butte des Morts.

Master Comment 5.43

Commenters represented that natural attenuation should be the benchmark for evaluating remedial alternatives.

Response

WDNR and EPA agree with this comment. Natural recovery has been used as the benchmark and has been used for comparison with the various action levels and several key thresholds including human health, ecological health, and transport to Green Bay. This comparative analysis is included in Section 10 of the FS.

Master Comment 5.44

Commenters stated that when natural attenuation is compared to the proposed remedy, there is no measurable benefit to the Lower Fox River or Green Bay and that dredging has no net environmental benefit over natural recovery. The commenters go on to say that the proposed remedy would increase PCB export to Green Bay and hinder natural attenuation in OU 4.

Response

WDNR and EPA disagree with this statement. Section 8 of the Lower Fox River and Green Bay FS compares the "no action" scenario to various RALs using water quality models. The results show a reduction in annual PCB loading from the Lower Fox River of over 90 percent when active remediation is conducted in OUs 1, 3, and 4.

It is possible that the commenters arrived at this conclusion by using a different water quality model than the WDNR, FoxSim. WDNR did review FoxSim and the results of that evaluation are included in Section 6.4 of this RS and in *White Paper No. 15 – FoxSim Model Documentation*.

Master Comment 5.45

Commenters stated that a capping scenario essentially "trades" a reduction in short-term risk for a long-term increase in potential risk associated with cap failure. For dredging, there is the short-term risk of PCBs released from newly exposed sediments and long-term risk reduction associated with mass removal. Short-term versus long-term risks need to be weighed.

Response

WDNR and EPA agree that short- and long-term risks need to be considered and balanced in the selection of a remedial action. WDNR and EPA have accomplished this through the comparison of remedial alternatives using the CERCLA nine criteria principles in Section 9 of the FS. The Agencies do have concerns about cap placement resulting in the bed of the Lower Fox River becoming the long-term repository for PCBs. If during the design phase of this project, information becomes available that strongly supports the construction of a cap over a portion of the OU 1 (or elsewhere), WDNR and EPA would require that appropriate cap monitoring and maintenance be part of that design. WDNR and EPA would also have to consider the appropriate fiduciary responsibility to require reconstruction or replacement in the event of cap failure. WDNR and EPA, while recognizing that some PCB mass will be released as a result of dredging, believe that the amount is not significant when compared to the amount of PCB material that is currently moving out into Green Bay and will continue unabated if no remedial action is undertaken.

Master Comment 5.46

Commenters stated that WDNR and EPA should select an overall remedial approach that is based on capping and that allows for the sensible development and implementation of capping and other possible technologies.

Response

WDNR and EPA did thoroughly evaluate capping as a remedial alternative in the Sections 6 and 7 of the Lower Fox River and Green Bay FS. In the FS for each OU, Alternative C represents dredging and Alternative F represents capping to the maximum extent possible. Capping as a technology is discussed Section 6 while Section 7 discusses how each alternative is applied to specific OUs. Section 9 of the FS then compares the possible remedial alternatives using the CERCLA nine evaluation criteria. Based on this evaluation and in consideration of the RAOs for these two OUs, dredging was selected for OU 1 while MNR was selected for OU 2.

The ROD does allow for a capping contingency in OU 1 if during the design phase of this project information becomes available that strongly supports the construction of a cap over a portion of OU 1. WDNR and EPA will consider that new information along with an evaluation of various parameters such as navigation channel location, water depth, scour potential, as well as if capping costs are less than dredging, then the Agencies would consider an alternative with a capping component.

Furthermore, any lessons learned in conducting pre-design, remedial design, and remedial implementation in OU 1 will be applied to downstream OUs. If a decision were made to allow such a partial cap to be constructed or some other technology utilized, the public would be informed.

Master Comment 5.47

Commenters stated that the proposed remedy cites a requirement for “monitoring in perpetuity” to ensure the isolation of contaminants as a negative aspect of capping (Proposed Plan at 18). However, the Proposed Plan acknowledges that dredging will not immediately achieve target risk objectives. The proposed remedy will require long-term monitoring until the target risk reduction is achieved. Therefore, it is not a reason to reject capping as a remedial option.

Response

WDNR and EPA agree that monitoring is necessary regardless of the remedial alternative selected and this is not the sole basis for not including a capping alternative. The WDNR has identified 40 years as being the period of post-remediation monitoring. If the Agencies’ RAOs have not been reached by that time, then monitoring will be needed until the goals are met. An important point to make, however, is that WDNR does have an ongoing fish tissue monitoring program that used to assess the need for consumption advisories. If need be, the additional monitoring efforts could possibly be included in that program. The FS did include a Model Long-term Monitoring Plan (LTMP), which will be expanded based on the selected remedy. WDNR does not have a contaminated sediment cap monitoring program.

Post-remediation monitoring is consistent with environmental monitoring programs for capping at other sites. For example, as described in *White Paper No. 6B – In-Situ Capping as a Remedy Component for the Lower Fox River*, the program described by the Agencies is consistent with those at two of the largest and oldest caps, East Eagle Harbor and the St. Paul Waterway in Washington state.

Master Comment 5.48

Commenters stated that the proposed remedy recognizes the possibility of effective combinations of natural attenuation, capping, dredging, and various kinds of disposal, but that the RI/FS and Proposed Plan largely fail to present and analyze combinations of alternatives.

Response

The WDNR and EPA disagree with this assessment. The FS clearly looked at and evaluated numerous technologies and combinations of technologies for remedial purposes. These technology evaluations and assessments on an OU-by-OU basis are in Sections 6 and 7 of the FS and are discussed in the Proposed Plan. For instance, Alternative F is typically a combination of capping and dredging, while the alternative in the Proposed Plan is a combination of dredging and MNR for the residual sediment in the OU where dredging is selected.

Master Comment 5.49

Commenters stated that the overall approach used is faulty because the proposed remedy focuses on PCB mass removal rather than minimizing exposure to PCBs. River areas subject to scouring have generally lost PCB deposits over the last 50 years, which has resulted in more than 90 percent of the PCBs being found in the De Pere to Green Bay Reach.

Response

This statement in not true. The Proposed Plan is based on risk reduction, not mass removal. This was explained in Section 9 of the Proposed Plan and the ROD. An incorrect assumption is that the River is a continuous depositional area. As WDNR has demonstrated in TM2g, the riverbed in OU 4 is dynamic in nature and can have significant bed elevation changes.

Master Comment 5.50

Commenters stated that a dredging remedy for the Lower Fox River was predetermined, and that WDNR and EPA failed to consider capping.

Response

The WDNR and EPA disagree with this statement. The RI/FS is an objective, unbiased analysis that resulted in the selection of a combination of dredging and MNR for the Lower Fox River and Green Bay. Capping to the maximum extent practicable was defined as a remedial alternative for all OUs. Capping areas in OUs 1 and 3 exceeded those proposed by the API Panel in their assessment (see Section 5.5.1 of this RS). Capping was considered in OU 4, but the area is less than that proposed by the API Panel due to a series of physical and institutional constraints that the API Panel did not consider. The Agencies did not select a capping remedy for OUs 1 or 2 as it is the Agencies' collective opinion that current conditions in the Lower Fox River cannot be maintained in perpetuity, and that the River, as the final repository of contaminated PCB sediments, does not conform with CERCLA. Having said that, the Agencies may consider capping as part of the ROD, provided that the physical, institutional, regulatory, and long-term fiduciary commitments outlined in *White Paper No. 6B – In-Situ Capping as a Remedy Component for the Lower Fox River*, can be achieved.

5.5 Evaluation of Submitted Alternatives

5.5.1 API Panel

Master Comment 5.51

Appleton Papers, Inc. provided funding to assemble an independent panel of university professors and scientists to evaluate the Proposed Plan for the Lower Fox River and Green Bay. The Appleton Paper, Inc. Panel (referred to as "the API Panel") completed a report entitled Ecosystem-Based Rehabilitation Plan (referred to herein as the "Panel Report") dated January 17, 2002 (The Johnson Company, 2002) that was submitted as part of the comments during the public response period. The Panel Report includes:

- An analysis of the Proposed Plan removal action and associated dredged decant water discharge issues;
- A conclusion that natural attenuation in the Lower Fox River as a remedial mechanism is too slow and will not achieve remedial goals;
- An alternative proposal to the Proposed Plan that includes capping of substantive sections for OUs 1, 3, and 4 (over 6 to 10 years);

- A proposal that would create/enhance fishery and water-dependent wildlife habitat in OUs 1, 3, and 4 on the capped surface;

- Continued reliance on the navigational dredging in OU 4 as a mechanism for PCB removal;

- Long-term monitoring plan for insurance of cap integrity (physical, chemical) and habitat;

- Long-term institutional/financial stewardship plan (operations and maintenance); and

- Appendix with cost-supporting information for the API Panel capping proposal.

Response

The WDNR and EPA appreciate the input and comments from the panel of university professors and scientists that Appleton Papers, Inc. and their former parent companies funded. The API Panel members have impressive credentials and years of experience. The Agencies regret that the API the Panel was not engaged earlier in the process and was not given the opportunity to work with WDNR and EPA prior to the release of the Panel Report. The WDNR was not informed of the existence of the API Panel until the Proposed Plan was released. More details on comments from the API Panel are included in other sections of this RS.

There are statements made by the API Panel that the Agencies agree with. For instance, the API Panel agreed with the RAOs defined by WDNR and EPA. The API Panel agrees natural recovery will not be effective for rapid risk reduction except in conjunction with other remedial work. The API Panel has also stated that the Lower Fox River has the appropriate river system characteristics for dredging.

There are also conclusions that are incorrect or show a lack of either regulatory or site-specific knowledge that may be problematic. For instance, the API Panel recommended adding a restoration component to the RAOs. WDNR and EPA agree ecosystem restoration and rehabilitation are critical components for the Lower Fox River and Green Bay. However, these issues are being addressed by the NRDA that WDNR is working on with other trustee agencies, including the USFWS and the Menominee and Oneida Tribes. This is a legally distinct issue. The API Panel states that wastewater effluent limitations will be a rate-limiting step and result in a much longer period of time to complete the dredging work. The Agencies strongly disagree with this statement; there are no limits to dredge decant water discharge. The Agencies (including the resource trustees) do not agree that the proposed capping represents a significant habitat improvement. Finally, WDNR and EPA do not agree that navigational dredging in the area referred to as OU 4B would be acceptable for a remedial solution. There remain significant PCB mass and contaminated sediments in that area despite years of ongoing navigational dredging. The API Panel does not consider the continuing burden on the USACE and the Port of Green Bay in their proposal.

The Agencies regret the loss of the opportunity to work with the API Panel earlier in the process. In order to have effectively evaluated their alternatives, the Agencies would have preferred that the alternatives use consistent models, consistent application of regulatory and institutional conditions in the state of Wisconsin. It appears to the Agencies that the API Panel had only limited time and their lack of site-specific knowledge and regulations as well as their unfamiliarity with the proposed remedy, the supporting documents such as the RI/FS and BLRA, and not having any detailed knowledge of Wisconsin regulations were significant handicaps to the development of their plan. It is also unfortunate that the Wisconsin contingent of the API Panel was not bought on board until the API Panel had already completed a majority of its work.

As part of this RS, a series of White Papers were written specific to the API Panel's report. These are briefly discussed in summarized Master Comments, below. The Agencies also received a large number of comments from the Fox River RP's, and the general public on the Panel Report. These are all discussed in the ensuing comments, below.

Wastewater Treatment

Master Comment 5.52

The comment authors claimed that the dredging recommended in the Proposed Plan was not viable because the quality and quantity of wastewater generated in the dredging process could not comply with water quality standards and associated WPDES permit limits, even using the most advanced wastewater treatment process. The wastewater quantity and quality limitations would, therefore, restrict the allowable wastewater discharge rate, thereby decreasing the allowable dredging rate and increasing the dredge schedule from the 7 years estimated in the Proposed Plan to as much as 60 years. Based on these assumptions the comment authors concluded that in-place sediment capping was the only viable alternative for remediation of the Lower Fox River sediment.

Response

It is the Agencies' position that the wastewater limitations imposed by the Panel Report are unfounded. In response to these comments the WDNR analyzed the assumptions used to support the comment conclusions, and performed an evaluation to determine if the expected dredge process wastewater characteristics and volumes would restrict or limit the viability of the Proposed Plan as claimed in the comments. The complete analysis is presented in *White Paper No. 7 – Lower Fox River Dredged Sediment Process Wastewater Quality and Quantity: Ability to Achieve Compliance with Water Quality Standards and Associated WPDES Permit Limits*. This analysis concludes that dredge process wastewater quantity and/or quality do not restrict the viability of dredging as recommended in the Proposed Plan, and do not, by themselves, justify the API Panel's alternative capping proposal. This evaluation essentially concludes that the expected quality and quantity of the dredge process effluent will comply with Water Quality Based Effluent Limits (WQBEL), and will not restrict the effluent discharge rate or associated dredge schedule. The expected effluent quality and quantity do not, therefore, limit the viability of the proposed remedial dredging project.

The comments assume that the wastewater discharge rate and quality are limited by the Lower Fox River's assimilative capacity and applicable Water Quality Standards and associated permit limits. In response, the WDNR's Bureau of Watershed Management completed two evaluations of the need for WPDES permit limits, copies of which are contained in *White Paper No. 7 – Lower Fox River Dredged Sediment Process Wastewater Quality and Quantity: Ability to Achieve Compliance with Water Quality Standards and Associated WPDES Permit Limits*. The first evaluation addressed the need for WQBELs for toxic compounds, and the second evaluation addressed Biochemical Oxygen Demand/Dissolved Oxygen (BOD/DO) issues. The WDNR evaluated effluent quality data and bench-scale test Priority Pollutant data from the Lower Fox River Deposit N and SMU 56/57 demonstration projects, along with the estimated discharge rates contained in the Proposed Plan and those estimates provided in the comments. Since the same sand filtration/carbon adsorption technology or equivalent wastewater treatment technology applied in the demonstration projects is proposed for full-scale remediation, it is assumed that the demonstration project effluent quality would be similar to and representative of full-scale effluent quality.

This analysis concluded that the BOD load from the dredge process wastewater would only use a small fraction of the available Lower Fox River BOD assimilative capacity; therefore, effluent BOD would not restrict implementation of the Proposed Plan. The analysis also concluded that PCBs, mercury and ammonia were the only other substances of concern. It was determined that PCB and mercury limits could be calculated using the alternate limit approach provided in Wisconsin Administrative Code (WAC) NR 106.06(6), which would not restrict the wastewater discharge rate or dredge schedule contained in the Proposed Plan even at the much higher API Panel-estimated discharge rates. Expected effluent ammonia concentrations were evaluated and a determination made that they were well below expected permit limits so ammonia limits would not likely be needed. This analysis concluded that the expected effluent quality generated from implementation of the Proposed Plan would not limit the wastewater discharge rate or the associated dredge rate or schedule. Wastewater discharge rates or permit limitation do not prevent implementation of the Proposed Plan.

Additional significant specific conclusions from *White Paper No. 7 – Lower Fox River Dredged Sediment Process Wastewater Quality and Quantity: Ability to Achieve Compliance with Water Quality Standards and Associated WPDES Permit Limits* include:

- The wastewater quality achieved from the Lower Fox River Deposit N and SMU 56/57 demonstration projects provides the best representation of the effluent quality expected from the full-scale dredging of the Lower Fox River. These data should be used for estimating expected effluent quality not those assumed by the comment authors.

- Effluent quality would not limit the ability of the project to comply with expected wastewater WPDES permit limits.

- Effluent quality would not restrict the expected effluent discharge rate based on the Lower Fox River assimilative capacity for cadmium, dieldrin, endrin, mercury, or any other parameter.

- WQBEL for Toxic and Organoleptic compounds regulated under WAC NR 106, are only needed for PCBs and mercury.

- PCB and mercury WQBELs will be determined using the Alternate Limit procedures provided in WAC NR 106.06(6), because background Lower Fox River concentrations of PCBs and mercury exceed water quality standards.

- The Lower Fox River assimilative capacity for BOD is indeed fully allocated; however, much of that capacity is unused by the permitted dischargers. Effluent from full-scale implementation of the proposed dredging plan would only use a small portion (less than 10 percent) of the unused or available assimilative capacity of the River.

- A significant portion of unused capacity is held by the PRPs and can be formally or informally reallocated to the discharge of the remediation project.

- Effluent quantity estimates contained in the comments are not reasonable, do not limit the allowable dredge rate and would not extend the dredge schedule beyond that estimated in the Proposed Plan.

- Discharges from two pilot dredging projects have been permitted under Wisconsin regulations.

More detailed responses to each of these “bullets” items are provided below in Master Comments 5.53 through 5.60, which address whether the expected effluent quality and quantity can comply with expected permit limits.

Finally, as a general response, the Agencies requested the Dr. Michael Palermo, an internationally recognized expert in both capping and dredging, evaluate the restrictions imposed on a dredging alternative by the API Panel. In *White Paper No. 6A – Comments on the Panel Report*, Dr. Palermo concludes that “the (Panel) report seems to paint an overly optimistic picture for capping and an overly pessimistic picture for dredging. The rate at which dredging is assumed to occur is severely hampered by an assumed constraint on river assimilative capacity which would likely not be imposed on a major remedial project.”

Master Comment 5.53

Commenters stated that remediation process wastewater must be treated to meet the most restrictive federal and state water quality standards and requirements prior to discharge to the Lower Fox River and that WPDES rules preclude the issuance of a discharge permit if a discharge will not attain water quality standards and that water quality standards for Bioaccumulative Chemicals of Concern (BCCs) for new or increased discharges must be the most stringent parameters contained in Chapter NR 105.

Response

The API Panel commented that remediation process wastewater must meet applicable state and federal requirements, and that WPDES rules preclude the issuance of a discharge permit if the discharge will not attain Water Quality Standards (WQS), and that WQSs for BCCs for new or increased discharges must be the most stringent standard contained in Chapter NR 105. The WDNR agrees that any wastewater discharge must meet state and federal requirements but does not agree that those requirements restrict the wastewater discharge to the extent concluded by the API Panel. This comment contains two major issues requiring a response.

The first issue is that of whether the remediation process wastewater discharge should be considered a new or increased discharge. Legally, the discharge of remediation process wastewater could be considered a new or increased discharge, however, realistically the discharge is not new and is not a net increase, since the sediment is already in the Lower Fox River and contributing contaminants to the system. In fact, another API Panel comment points out the placement of the Lower Fox River and inner Green Bay on the Clean Water Act's Section 303 (d) list, as impaired waters not currently meeting Water Quality Standards, is in part due to the sediment contribution of PCBs, DDT, dieldrin, arsenic and mercury. Although there may be a short-term increase of contaminants in the water column from the dredging process, the net long-term reduction in the overall presence and contribution of contaminants from the sediment outweighs the short-term increase. It is, therefore, most appropriate to view the remedial dredging project as an action to reduce or eliminate an existing discharge of contaminants. Although this view does not actually change how limits are calculated under Wisconsin regulations it is important in maintaining perspective of the project goal to remove contaminants, and their associated impacts, which are already present in the River system.

The second issue is that of whether Wisconsin's regulations limit the WDNR's ability to issue a WPDES permit in this case, and if the most restrictive permit limits would apply. Wisconsin rules do not require the application of the most restrictive WQS as the permit limit in cases where the receiving water background concentration exceed the WQSs. Chapter NR 106 is the WAC containing the requirements for the calculation of water quality based effluent limits for toxic and organoleptic substances discharged to surface waters. NR 106.06(6) establishes the condition under which alternative limits based on background concentrations are determined and provides the flexibility to apply a Net Environmental Benefit concept when addressing situations such as this, where the contaminants are already in the system. This section of the code essentially says that whenever background concentrations for toxic or organoleptic substances in the receiving water exceed the applicable WQS, and at least 10 percent of the source water is from the receiving stream, the effluent limit for that substance may be set at the background concentration, or an alternate limit or requirement may be determined. An alternate limit or requirement may be determined if the discharger's relative contribution of the mass of the contaminant to the receiving water body is negligible in the best professional judgment of the WDNR, and if the WDNR judges that Best Demonstrated Treatment Technology Reasonably Achievable is provided. The alternate limit or other requirement may include one or more of the following permit conditions, a numerical limit (which can be greater or lower than the WQS), a monitoring requirement, or a cost-effective pollutant minimization program (which could include a specific treatment technology or performance standard).

Since the Lower Fox River is actually l00 percent of the source water (far greater than 10 percent), and background concentrations exceed the WQSs for

PCBs and mercury, which are toxic substances subject to the provisions of NR 106, alternative limits are appropriate for these substances. DDT and dieldrin were not detected, and arsenic was either not detected or not present at levels requiring permit limits in the Deposit N and SMU 56/57 demonstration project effluents. Application of the same or similar technology utilized in the demonstration projects is considered by the WDNR to be Best Demonstrated Treatment Technology Reasonably Achievable, and the PCB and mercury mass contained in the wastewater discharge are considered negligible. Therefore, the application of alternative limits or requirements other than background concentrations is reasonable, appropriate and fully in conformance with existing rules.

Master Comment 5.54

Commenters stated that treated wastewater generated in the remediation process (at the rate estimated by the API Panel of 4.3 million gallons per day (mgd) in OU 1, and 23.7 mgd in OUs 3 and 4) even using the most advanced treatment technology can not achieve the applicable Water Quality Standards and associated permit limits.

Response

The API Panel commented that achieving compliance with expected WQBEL would require wastewater treatment far exceeding Best Demonstrated Available Technology (BDAT), which would require the application of unproven technology with many associated risks. The API Panel's report includes a table (Table B-4) comparing the expected performance from BDAT treatment to anticipated WPDES Permit WQBELs, which showed compliance with WQBELs was not achievable. Although an interesting academic exercise, this analysis and conclusion are not appropriate for the proposed sediment remediation project, since there is Deposit N and SMU 56/57 demonstration project effluent priority pollutant data available documenting wastewater treatment performance which is orders of magnitude better (lower) than those cited for BDAT in the report, and below WQBELs for all parameters except PCBs and mercury. Substituting the Lower Fox River demonstration project data for the BDAT data in the report reveals that the application of the same or equivalent technology utilized in the Lower Fox River demonstration projects can achieve compliance with WQBELs. This technology is not unproven but is standard technology applied in similar remediation projects around the world.

Master Comment 5.55

Commenters also felt that treated wastewater from the Demonstration Projects did not comply with WPDES permit limits.

Response

The Panel Report also commented that the demonstration projects did not meet applicable WPDES permit limits. Although, there were instances where effluent quality exceeded permit limits, a general characterization that the projects were not compliant does not accurately represent the typical effluent quality and treatment performance that was achieved. The WDNR's overall assessment of the project performance is that substantial compliance was achieved for all parameters except BOD, which frequently exceeded the permit limit of less than 2 mg/L in the SMU 56/57 project. Although the BOD limit was exceeded, the project BOD discharge used only a small percent of the available assimilative capacity of the Lower Fox River. The BOD issue will be addressed in full-scale remediation project permitting by temporary transfer of unused assimilative capacity from other permitted dischargers responsible for the discharge of PCBs.

The Panel Report itemized the following violations for each of the projects:

- For Deposit N, the Panel Report claims WPDES permit limit exceedances for the PCB weekly average concentration and mass, the BOD weekly average concentration, and the TSS monthly average concentration. Detailed review of the Deposit N permit and discharge data reveal that PCB weekly average concentration and mass limits were not exceeded because the permit does not contain weekly average limits, and only contains monthly average limits which were not exceeded. Review of the effluent BOD data shows that all the weekly values were less than the level of detection (LOD less than 2 or less than 3 mg/L) except for three results of 2, 3, and 5 mg/L. Review of the TSS effluent data revealed monthly average TSS concentrations (for the 5 months of discharge in 1998 and 1999) were 0, 1.2, 3.1, 0.96, and 0.87 mg/L, none of which were violations. It is not clear why the Panel Report claimed the monthly average concentration limit was exceeded, except that in the first 5 daily analysis the TSS results were all reported as less than the LOD at an LOD of less than 8.8 or less than 10 mg/L. Table 5 of the Panel Report presents the actual discharge value as " <1 – <8.8" which when compared to the monthly average limit of 5 mg/L could, if one assumes the true value was between the LOD and the 5 mg/L, be considered a violation. The LOD of less than 8.8 is an unacceptably high LOD and was subsequently reduced to less than 1 mg/L beginning the sixth day of operation. Based on this review, the Deposit N wastewater treatment is considered to be in substantial compliance with its WPDES limits and to have consistently achieved a high-quality effluent.

- For SMU 56/57, the Panel Report claims that WPDES permit limits were exceeded for PCBs, the TSS daily maximum concentration (6 times), and the mercury monthly mass limit, and long-term average values for both TSS and BOD. Review of the PCB effluent data reveals that all of the weekly PCB analyses results were less than the LOD, at an LOD of less than 0.33 or less than 0.26 mg/L, except for one value of 0.37 mg/L. It is not clear how this could be considered a violation of the monthly average permit limit of 1.2 mg/L. Review of the effluent TSS data shows that the daily maximum and monthly average permit limits were exceeded in the first month of the 1999 project due to problems encountered with the design and operation of the wastewater treatment system. Corrective modifications were completed in about the sixth week of the project, after which effluent TSS concentrations were consistently maintained at a daily average concentration of between 2 and 4 mg/L, except for two results at the end of the project. The effluent TSS in the second year of the project averaged well below 5 mg/L with only one daily value greater than 10 mg/L. Review of the effluent BOD data shows that in 1999 the average BOD was 11.5 mg/L, except that after the treatment system modifications were completed in the sixth week, the average was about 7 mg/L. Although this exceeded permit limits, it was only a small fraction of the unused assimilative capacity available in the River.

Review of the effluent mercury data showed the average concentration was 16.5 ng/L in the 1999 project, and in the 2000 project mercury concentrations in 14 of the 19 samples were less than the LOD of 0.1 ng/L, and five values were between 0.1 to 0.45 ng/L. The year 1999 effluent mercury monthly mass discharge did exceed the permit limits because average concentration was 16.5 ng/L instead of the 5.6 ng/L (background) upon which the mass limit was calculated. The year 2000 effluent mercury is well below the 5.6 ng/L background level as are the Deposit N effluent concentrations. The alternate limit process in NR 106.06(6) as previously discussed does allow flexibility in setting limits greater than background; however, prior to considering an alternate limit greater than background, wastewater treatment system design similar to the Deposit N and SMU 56/57 2000 projects would need to be considered.

Master Comment 5.56

Comments claimed that the expected wastewater discharge rate and quality would exceed the assimilative capacity of the Lower Fox River. Assuming the very best treatment results reported, the assimilative capacity of the River restricts the maximum discharge rate to 4.25 mgd, based on assumed treated effluent concentrations of dieldrin, endrin, cadmium, and mercury.

Response

The Panel Report concludes the assimilative capacity of the Lower Fox River would limit the discharge rate of sediment remediation process wastewater to 4.25 mgd, based on assumed effluent concentrations of dieldrin, endrin, mercury, and cadmium. It appears these assumed contaminant concentrations were obtained from a 1985 text authored by J. W. Patterson (a member of the API Panel) and were characterized as the best reported wastewater treatment results. Using these assumed concentrations, the maximum wastewater discharge rate, which would not exceed the assimilative capacity of the River, was calculated to be 8.4 mgd for cadmium, 1.25 mgd for mercury, and 3.12 for endrin producing an average of 4.25 mgd. Dieldrin had a much lower assimilative capacity based discharge rate of 0.04 mgd, but was discounted in their report. The 4.25 mgd average along with the API Panel-estimated wastewater generation rate of 4,100 gal/cy of dredged sediment (five times the Proposed Plan estimate) was used to calculate that the dredge rate would be restricted to 1,050 cy/day, extending the dredge schedule from about 7 years to 37 to 60 years. Although the Panel Report assumed contaminant concentrations may be suitable to use when site-specific data is not available, they are not appropriate to use in this case given the availability of substantial demonstration project data from the Lower Fox River. As part of the demonstration projects, four separate sets of treated effluent samples were analyzed for all the priority pollutants. Two were from bench-scale tests using Deposit N and SMU 56/57 sediment as part of the pre-design phase of the projects. The two other analyses were completed on effluent collected during normal operation of the actual Deposit N and SMU 56/57 demonstration projects. Dieldrin and endrin were not detected in any of the four analysis at a LOD 10 to 100 times lower than the Panel Report assumed value. Three of four samples did not detected cadmium at an LOD of 20 to 50 times lower than the assumed value, with one detected cadmium value at one-tenth the assumed value. Mercury was only done on three of the four priority pollutant analyses, however, it was also analyzed weekly during the demonstration projects. Mercury was not detected in any of the three priority pollutant analyses with LODs of 10 to 1,000 lower than the assumed value. During the SMU 56/57 year 2000 demonstration project about 19 mercury samples were collected of which 14 had no detects at an LOD 2,000 times lower than the assumed value, and five values had detected concentrations, the highest of which was 500 times lower than the assumed value. The Deposit N project effluent mercury values were mostly detectable at levels similar to those detected in SMU 56/57 2000. Deposit N and SMU 56/57 (1999) influent wastewater mercury analysis was also done on samples collected just prior to the wastewater treatment process which showed the influent mercury concentrations were also far below the assumed values used by the API Panel for treated effluent.

It is not clear from this comment why mercury was included in this analysis since it was already identified as having no available assimilative capacity because River background concentrations already exceed the mercury WQS. As discussed else where in this response, since mercury is present in the background receiving water at concentrations exceeding the WQS, Chapter NR 106.06(6) allows for effluent limits at or above background concentrations. The permit limits set for mercury in the demonstration projects were based on background concentrations.

Replacing the Panel Report's assumed contaminant values with the data generated in the demonstration projects, but keeping all the other assumptions the same, increases the assimilative capacity based wastewater discharge rate at least by a factor of 10, from 4.25 mgd to 42.5 mgd. This is well beyond the maximum discharge rate of 23.7 mgd estimated by the Panel Report based on the Proposed Plan's dredge rate of 5,770 cy/day (assuming their wastewater generation rate of 4,100 gal/cy). Based on this analysis, the WDNR does not believe that the Lower Fox River's assimilative capacity for cadmium, mercury, dieldrin, and endrin will limit the wastewater discharge rate and associated dredge rate and will, therefore, not extend the dredge schedule beyond the 7 years estimated in the Proposed Plan.

Master Comment 5.57

Commenters stated that no assimilative capacity is available for BOD since that capacity is already fully allocated.

Response

The API Panel commented that no assimilative capacity for BOD is available because that capacity is already allocated to existing dischargers. Although the River is fully allocated, much of that allocated capacity is not used, so excess allocation could be temporarily transferred to the sediment remediation project, especially since much of the unused allocation is held by the responsible paper companies. Although it is widely understood that the existing permittees only used a portion of their allocated capacity, no actual calculation to quantify that unused capacity had been done. In response to this issue, WDNR staff have evaluated the last 3 years of discharge data and calculated on a daily maximum permit limit basis the least amount of unused Wasteload Allocation (WLA) for each of the permittees in each of the three WLA clusters. This analysis documented there was substantial unused WLA capacity available in all three clusters for the sediment remediation project. Cluster I roughly corresponds to OU 1, and Cluster II contains most of OU 2, and Cluster III contains all of OUs 3 and 4. Cluster I extends from the outlet of Lake Winnebago to just upstream of Appleton Lock 1 and dam, and has a minimum unused WLA of 10,688 lbs/day. Cluster II extends down stream from the Appleton Lock 1 and dam to just below the Rapide Croche lock and dam and has a minimum unused WLA of 29,536 lbs/d. Cluster III extents from Cluster II to the mouth of the Lower Fox River at Green Bay and has a minimum unused WLA of 39,531 lbs/d. This analysis looked at the very worst-case scenario and did not factor in the multiplier applied to daily maximum permit limits. Assuming application of the permit limit multiplier and assuming normal flows and temperatures, the actual unused WLA would probably be twice that shown here.

In order to calculate the BOD load expected from the remediation project, a design flow of 1.4 and 10 mgd, which is twice the flow rate estimated in the Proposed Plan for OU l and OUs 3 and 4 was assumed. Next an average effluent BOD concentration of 15 mg/L was selected. The 15 mg/L value is very conservative because it is one of the highest effluent BOD values reported and is two to three times higher than the average BOD concentration experienced in the SMU 56/57 demonstration project. Deposit N effluent BOD values were all but a few less than the level of detection less than 2 or less than 3 mg/L). Assuming a discharge rate of 1.4 mgd in OU 1 and a discharge rate of 10 mgd in OUs 3 and 4, with an effluent BOD concentration of 15 mg/L, results in a discharge of l75 lbs/d in OU 1 and a discharge of about 1,300 lbs/d in OUs 3 and 4. Comparing these values to the minimum unused BOD WLA of 10,000 lbs/d in OU 1, and the minimum unused BOD WLA of 30,000 to 40,000 lbs/d in OUs 3 and 4, it is clear the remediation project discharge would have no significant impact on water quality and would not limit the feasibility of the dredging project.

Master Comment 5.58

Commenters felt that the wastewater generation rate should be 4,100 gallons/cy of dredged sediment, which is five times the proposed rate used in the Proposed Plan. This assumption increases the volume of dredge process wastewater needing treatment from the 0.7 to 5.0 mgd estimated in the proposed plan to the API Panel estimate of 4.3 to 23.7 mgd.

Response

The Panel Report commented that the dredge process wastewater generation rate should be estimated from the history of other projects which was presented in Table B-1. They concluded the more appropriate wastewater generation rate to use for planning is 4,100 gal/cy, which is the average of the projects in Table B-l, instead of the 542- 880 gal/cy they say WDNR assumed. Using the API Panel value of 4,100 gal/cy results in about a five-fold increase in wastewater volume needing treatment, increasing the estimated wastewater discharge rate to 4.3 mgd in OU l and 23.7 mgd in OUs 3 and 4. Review of the Table B-l project wastewater generation rates showed that seven of the eight projects had wastewater generation rates between 1,000 gal/cy and 5,600 gal/cy with an average of 2,842 gal/cy. One project showed a wastewater generation rate of 11,111 gal/cy, which is about twice that of the next highest value of 5,576 gal/cy, resulting in an average of 4,100 gal/cy. This single value clearly skews the average and does not appear appropriate to use, especially given the small sediment volume dredged in that project. The SMU 56/57 project wastewater generation rates were about 1,300 gal/cy in year 2000, and 2,400 gal/cy in year 1999, averaging 1,734 gal/cy for the total project. The year 2000 SMU 56/57 project is considered to be more representative of a full-scale operation because it did not have the same problems encountered in 1999 which due to the short duration and smaller dredge volume probably skewed the wastewater production rate to the high side. Deposit N in the first two larger phases of the project ranged from 1,843 to 2,705 gal/cy, with an overall (Phases 1 through 4) average of about 3,000 gal/cy. Given the small volume (approx. 11,000 cy) of sediment dredged, Deposit N is considered less representative of a full-scale operation than is SMU 56/57 in year 2000. The Lower Fox River demonstration project wastewater production rates are considered by the WDNR to be more representative than that estimated by the Panel Report since they were actually done in the Lower Fox River environment, and are not skewed by data from dissimilar projects. It is also expected that full-scale operation efficiency would exceed that of the demonstration projects due to the scale of the project (7 million cy), the longer duration, possible application of greater efficiency technology, and greater contractor familiarity with the specific Lower Fox River conditions. Based on this analysis, it is reasonable to assume that wastewater production rates will be at a minimum less than one-half to one-third of the API Panel estimate, resulting in wastewater volumes of less than 2 to 10 mgd. Although the WDNR believes the wastewater volumes will be far less than those estimated by the API Panel, the WDNR has concluded, in the previous analysis, that even if the flows were as high as the Panel Report estimated, there would not be any limitation to the dredge rate and associated dredge schedule.

Master Comment 5.59

Commenters stated that assuming a maximum wastewater discharge rate of 4.25 mgd and a wastewater generation rate of 4,100 gal/cy of dredged sediment, results in a maximum dredge rate of 1,050 cy/day, which extends the estimated dredge schedule from the Proposed Plan estimate of 7 years to as much as 37 to 60 years.

Response

The Panel Report commented that restriction of the wastewater discharge rate to 4.25 mgd, with an assumed wastewater generation rate of 4,100 gal/cy of dredged sediment, would result in a maximum dredge rate of 1,050 cy/day, which would extend the projected dredge schedule from 7 years to as much as 37 to 60 years. As shown in the Responses to Master Comments 5.55 and

5.57 discussions, the WDNR believes the wastewater discharge rate is not limited to 4.25 mgd, and the wastewater production rate will be much lower than 4,100 gal/cy, therefore, the dredge rate is not limited to 1,050 cy/day and the dredge schedule will not extend beyond the Proposed Plan's estimate of 7 years. The WDNR believes that the dredge rate of 5,770 cy/d estimated in the Proposed Plan is a reasonable assumption. A comment made by one of the Wisconsin contributing reviewers to the API Panel, at the May 2002 Science and Technical Advisory Committee (STAC) meeting, indicated that Donald Hayes, a member of the API Panel, said that OU 4 could be dredged in 2 years if the sediment was placed in a confined disposal facility (CDF). Although it was not explained how this assumption fit with the wastewater discharge concerns of the API Panel, it does support the conclusion that the proposed dredge rate of 5,770 cy/day is not unreasonable, and that even greater dredge rates may be technologically feasible.

Master Comment 5.60

Some commenters claimed that extending the dredge schedule to as much as 60 years results in far greater PCB exposure and environmental impact than would capping, making capping a better solution.

Response

The Panel Report commented that extending the dredge schedule to as much as 60 years resulted in far greater PCB exposure and environmental impact than would capping, which is estimated to takes 10 years. Based on the previous analysis and discussion the WDNR believes the dredging schedule will not be extended beyond the Proposed Plan estimate of 7 years due to wastewater discharge limitations. The proposed dredging plan would not, therefore, result in greater PCB exposure due to project schedules, but instead would take less time to implement and would address more of the sediment surface area than would the API Panel capping proposal.

Natural Attenuation

Master Comment 5.61

The Panel Report noted that the process of natural sedimentation in the River occurs at a rate too slow to isolate areas affected by high PCB concentrations, or to achieve the RAOs in an appropriately short period of time. "For these reasons, the Panel does not believe that natural recovery could serve as a feasible primary or singular remedy" (API Panel Report, Page 7; The Johnson Company, 2002). However, the API Panel did accept an annual rate of 10 percent per year as part of its determination and evaluation of remedial success.

Response

The WDNR and EPA agree with the API Panel in stating that natural attenuation will proceed too slowly to meet the RAOs. The decision to proceed with active remediation was based upon risk reduction and time necessary to reduce or eliminate consumption advisories for fish. The Agencies concur that the processes involved in natural recovery are not amenable to an effective and expeditious remediation of the Lower Fox River. The Agencies do not believe the API Panel's assumed 10 percent annual reduction in PCB sediment concentrations.

Risk Reduction

Master Comment 5.62

That risk reduction would be more quickly and reliably achieved with the capping alternative proposed is a central argument of the Panel Report. The API Panel contends that capping would isolate the PCB contamination from biological availability, achieve the SWAC, lower resuspension in water, and in general achieve risk reduction with greater certainty and speed than the Proposed Plan removal action.

Response

The Panel Report proposal does not achieve the risk reduction goals set by the Agencies for any of the OUs. The risk reduction aspects of the Panel Report are examined in *White Paper No. 5A – Responses to the API Panel Report*. The net result is that the API Panel's alternative is less protective to human health and the environment, does not meet the CERCLA preference for removal and treatment, has no demonstrated certainty in the design, no demonstrated surety in its construction costs, and does not account for long-term responsibility for cap failure.

In the Proposed Plan, the Agencies evaluated the range of potential RALs in the FS, and selected 1 ppm based upon the nine CERCLA criteria (see Master Comment 9.1). An RAL of 1 ppm would result in SWACs of 0.19, 0.27, and 0.16 ppm in OUs 1, 3, and 4, respectively. The API Panel proposed that a SWAC of 0.5 ppm be used as a design criterion. The proposed SWAC was not based on a site-specific assessment of risk, but rather on an engineering "implementation efficiency" estimation. This is a fundamental requirement of CERCLA, and a finding of the NRC committee. When examined on a similar basis, the actual SWAC in the API Panel's proposal for the three OUs are 0.71 ppm for OUs 1 and 4, and 0.56 ppm in OU 3. The comparable RAL in the FS to achieve the API Panel-generated SWACs is 5 ppm. Thus, the SWACs in the Panel Report are four times greater than the risk reduction goal identified in the Proposed Plan. The net result is: (1) the API Panel's proposal does not meet the risk reduction goals of the Proposed Plan; and (2) comparison by the

API Panel to the Proposed Plan risk reduction, technical implementability, or costs are erroneous – the area and volume covered in the Panel Report is only one-half of that in the Proposed Plan. As noted by Dr. Palermo, "A direct comparison of SWAC reduction rates for two alternatives with differing action levels is inappropriate when those action levels drive the timeline for completion of the respective actions."

Cap Design

Master Comment 5.63

The Panel Report proposed alternate criteria for cap design from the FS, and applied what they deemed to be appropriate cap thickness and armoring throughout the River. They maintain that the alternate designs that are presented in the Panel Report (e.g., design thickness, materials, armoring) follow procedures defined in the EPA and USACE guidance documents (Palermo et al., 1998a, 1998b). They develop and present different designs for different deposits/SMUs for OUs 1, 3, and 4 using the 5 ppm RAL (see Master Comment 5.61) footprint. The costs presented in the Panel Report are then compared to the Proposed Plan results, with a conclusion that the API Panel proposal is less expensive to implement than that of the Proposed Plan

Response

WDNR and EPA believe that the while capping is and can be an appropriate part of a remedial design, it should be a part of a remedy component, and not the sole component as is offered in the Panel Report. Furthermore, the Agencies believe that the design(s) provided by the API Panel are not technically sound; the design is based upon computer models and have never been implemented anywhere in the world. The API Panel cannot point to a single cap with this design that has been implemented successfully in any environment, much less a riverine environment.

When compared on an equal RAL basis, the FS capping alternatives for OU 1 cover the same areas and more than those proposed by the API Panel (see FS Figures 7-17 and 7-30, relative to Panel Report Figures 7 and 8). Ice scour also remains a considerable constraint on cap placement in water depths of 3 feet or less. In addition, WDNR fisheries biologists indicate that as a habitat consideration to discourage carp, a minimum water depth of 3 feet should be maintained. This appeared to be considered by the Panel Report for OU 1. In addition, Dr. Palermo's *White Paper No. 6A – Comments on the API Panel Report* and *White Paper No. 6B – In-Situ Capping as a Remedy Component for the Lower Fox River* point out that long-term lake level changes (from +5 to -1 feet) should be accounted for in designing for these restrictions for OU 4.

Other technical issues were equally of concern to the Agencies. As pointed out by Dr. Palermo, technical issues for capping not fully considered in the report include:

- The rationale in selecting total cap thickness,
- The basis of design for the chemical isolation component;
- Consolidation-induced advection;
- Potential mixing of contaminated sediments and cap material; and
- Constraints on capping in shallow-water areas

A detailed design effort for any selected capping remedy should address these and all pertinent design considerations. While the report considers some design issues, the information on cap design is not clearly presented and there is insufficient information offered to verify the proposed design with respect to all the issues.

The total thickness of a cap, and the composition of the cap components, should be based on an evaluation of all the pertinent processes for the Site and the ability of the design to achieve the intended functions of the cap. Some of the processes for design of cap components can be evaluated rigorously with models, etc., but others require engineering judgment and experience. A major common thread for all the area-specific designs is a 12-inch total thickness (see comment above). Another common thread for most of the designs is a 3-inch fine sand layer, which is presumably intended to be the chemical isolation layer. However, several of the areas show a design of only 12 inches of coarse sand. A coarse sand would normally have little or no fine fraction, therefore little or no adsorptive capacity for chemical isolation. If an additive such as activated carbon were used to boost adsorptive capacity, there would be a high potential for separation from a coarse sand during placement. Dr. Palermo concludes that "the design for these areas therefore seems non-protective from the standpoint of chemical isolation," and that "… in my judgment, a total cap thickness of 12 inches seems non-conservative for a major site like the Fox River."

A summary of all capping projects to date is provided in *White Paper No. 6B – In-Situ Capping as a Remedy Component for the Lower Fox River*, shows that the caps built to date average within the 2- to 3-foot range of sand thickness. All of these caps are in lakes, estuaries, or deeper water not subject to erosional actions. Given all of the data above, the Agencies judge the Panel Report design to be technically deficient and too broadly applied across at least OU 4.

Master Comment 5.64

The API Panel, and several of the RPs, suggest that the Panel Report proposal is more implementable than the Proposed Plan remedy with issues related to technical and administrative feasibility. They contend that: (1) the ability to construct and operate proposed technology (use and reliability), (2) ability to obtain applicable permits or meet permit requirements, and (3) degree to which coordination can be achieved, is far superior to that offered by the Proposed Plan.

Response

WDNR and EPA disagree with the API Panel and the RPs on this comment. Ease of construction is not assured for the API Panel capping proposal. There has never been a cap constructed anywhere in the world on this scale, much less in a riverine environment. That the cap can be constructed is not an issue. When compared to the kinds, numbers, and availability of dredging equipment, the API Panel does not point out that there are less than a dozen vessels or specialized equipment for capping throughout the world. *White Paper No. 6B – In-Situ Capping as a Remedy Component for the Lower Fox River* shows several representative mechanisms for cap placement, but most of the caps constructed to date use split hull barges; a technology inappropriate to the Lower Fox River. The API Panel also does not mention any mechanisms for placement that would take into account the low shear strength of the sediments within the Lower Fox River, and the specialized techniques that are needed to successfully place material under these conditions. In fact, the API Panel's consultant, The Johnson Company, has encountered significant problems with shear failure at the demonstration cap project at the Pine Street Canal Superfund Site in Burlington, Vermont (Tom Fredette, USACE, personal communication). WDNR and EPA's consultant to the Lower Fox River, The RETEC Group, Inc., has successfully demonstrated capping techniques on low-shear strength sediments at two recent projects, so the Agencies are aware it can be done. The time taken to apply the material, however, is critical and probably underestimated in the Panel Report. Thus, the Agencies conclude that capping construction is not assured.

The Agencies also take issue with the statement that obtaining permits for cap construction will be easier for the Panel Report's proposal. The API Panel was perhaps not aware of Wisconsin state statutes relating to the construction, fill, or use of aquatic lands. These are described in Section 6 of *White Paper No. 6B – In-Situ Capping as a Remedy Component for the Lower Fox River*. For properties clearly identified as state-owned aquatic lands, capping would require obtaining a Lake Bed Grant from the Wisconsin State Legislature. This is not a "simple" permitting requirement. The grant would have to go to the adjacent municipality, and the uses of any filled area would have to be specified in the legislation. A Lake Bed Grant, for example, would have to be obtained from the legislature for OU 1. It is likely that a lease would be required for maintaining a cap in perpetuity. For OUs 3 and 4, easements may need to be sought from adjacent riparian property owners. Within OU 4, the

API Panel proposed capping within the federally-authorized navigation channel. Under federal law, this is not allowed unless specifically approved by an Act of Congress. Federally, Section 10 of the Rivers and Harbors Act of 1899 (22 CFR § 403) requires permitting for any construction that would impact the course, capacity, or condition of navigable waters of the United States (Palermo et al., 1998b). Any cap would be considered as an obstruction to navigation. Finally, floodplain zoning would need to be considered with the installation of any capping project. Wisconsin statutes prohibit the siting of solid and hazardous disposal facilities within a floodway. In addition, under state statutes, if the in-water structure results in a change to the 100-year flood elevation by as much as 0.01 of a foot, easements from affected property owners need to be obtained. Given the extensive areas and elevational changes in the Panel Report's proposal for OU 4, it is likely that floodplain zoning issues would be an overriding consideration in that reach. Thus, the Agencies believe in fact that the permitting and institutional requirements for a cap as proposed by the API Panel will be more difficult to implement.

References

Palermo, M. R., J. E. Clausner, M. P. Rollings, G. L. Williams, T. E. Myers, T. J. Fredette, and R. E. Randall, 1998a. *Guidance for Subaqueous Dredged Material Capping*. Technical Report DOER-1. United States Army Corps of Engineers Waterways Experiment Station, Vicksburg, Mississippi. Website: http://www.wes.army.mil/el/dots/doer/pdf/doer-1.pdf.

Palermo, M. R., J. Miller, S. Maynord, and D. Reible, 1998b. *Assessment and Remediation of Contaminated Sediments (ARCS) Program Guidance for In-Situ Subaqueous Capping of Contaminated Sediments*. EPA 905/B-96/004. Prepared for the Great Lakes National Program Office, United States Environmental Protection Agency, Chicago, Illinois. Website: http://www.epa.gov/glnpo/sediment/iscmain

Master Comment 5.65

The Panel Report states that capping OUs 1, 3, 4A could be achieved in 6 to 10 years time. They contrast this time with their estimates of dredging based on limits of wastewater treatment, and argue that there will be 60 years of removal action and exposure of subsurface PCBs.

Response

WDNR and EPA believe that the Panel Report is mistaken on two counts: (1) there are no limitations to wastewater treatment that will effect dredging production rates; and (2) that the time needed to resolve institutional, regulatory, and construction issues will likely result in more time than the API Panel assumed in their proposal. The Agencies believe that the FS is correct in noting that there are likely to be no differences in time to achieve dredging or capping alternatives on the Lower Fox River. The API Panel's proposed capping design and projected construction timeframes are not based upon any demonstrated similar projects. The Panel Report cannot point to a single implemented cap in a riverine system in the United States, Canada, or the world that has been successfully placed, monitored, and demonstrated long-term contaminant isolation. Rather, the API Panel relied on desktop computer models to justify the specific design in their plan. Furthermore, the API Panel's estimates of dredge times are based upon erroneous assumptions on discharge water quality that would restrict dredging operations.

Master Comment 5.66

The Panel Report maintains that their capping proposal results in achievement of the risk reduction goals defined in the RAOs, but at a cost less than the removal costs defined within the Proposed Plan. The API Panel, and several RPs, on that basis stated that the API Panel capping proposal should be the final alternative for the River, in lieu of the Proposed Plan.

Response

The Panel Report errs on a number of levels in making this comparison. As noted previously, the Panel Report's proposal does not meet the risk reduction goals of the Proposed Plan, places caps at physically inappropriate areas of OU 4, and considers a design that in the opinion of the world's leading expert in capping, is non-conservative. A direct comparison of cost is not applicable; the Panel Report assumes a residual risk level that is up to four times greater than that proposed by WDNR (see *White Paper No. 5A – Responses to the API Panel Report*).

Comparative costs between the Proposed Plan and the Panel Report are examined in *White Paper No. 5B – Evaluation of API Capping Costs Report*. Based upon that analysis, the following conclusions can be drawn:

- The Panel Report does not accurately portray compare remedial costs. The Panel Report compares its alternatives developed at a less protective RAL (5 ppm) with the Proposed Plan RAL (1 ppm). The practical result of this decision is that the Panel Report develops costs for an area that is only one-half of that managed by WDNR's Proposed Plan.

- When compared at the same RAL (5 ppm), contaminated sediment removal alternatives in the FS are less expensive, or equivalent, in cost to the API Panel plan for all three OUs.

- The Proposed Plan removal alternative for OU 1 (dredge with off-site disposal), at an RAL of 1 ppm is equivalent in cost to the API Panel capping alternative.
- The Proposed Plan removal alternative for OUs 3 and 4 achieves permanent removal of PCBs from the River at a lower (more protective) RAL, but are within 23 to 25 percent of the costs proposed by the Panel Report.
- The Panel Report costs, when projected onto the 1 ppm RAL footprint, are greater than removal costs in OUs 1 and 3, and equivalent to removal costs in OU 4.
- The capping design offered by the Panel Report did not consider addition of a foundation layer, nor incorporate any safety factors. Based on engineering judgment and experience at other sites, the API Panel cap thickness requires an additional 8 to 12 inches.
- When the technical adjustments to the cap design are applied, along with an accounting for the larger remedial footprint, the cost of the API Panel cap is either greater than or equivalent to the cost of removal in all OUs.

The Agencies believe that the Panel Report conclusion, when examined on an equivalent basis to the Proposed Plan, offers less risk reduction, is similar in cost to the removal defined in the Proposed Plan, and offers the additional benefit of no long-term commitment to operations, monitoring, and maintenance within the Lower Fox River.

Master Comment 5.67

A large number of comments were received from public and private concerns relating to the Panel Report. These included comments that supported the API Panel proposal for capping, as well as comments that were concerned about capping and preferred the removal alternative in the Proposed Plan. In addition, some commenters advocated a mixed position of capping and dredging.

Response

WDNR and EPA evaluated the API Panel's capping proposal, and found that it did not meet the RAOs and risk management goals as articulated in the Proposed Plan. In and of itself, the API Panel proposal is considered insufficiently protective as follows:

1) The Panel Report does not achieve the risk management goals of the Proposed Plan. The SWAC achieved with the API Panel capping

proposal is up to four times greater than the remedy decided for the ROD. Even accepting the API Panel's calculations, the estimated SWAC is 0.5 ppm on a river-wide basis. SWACs estimated for dredging recommended in the Proposed Plan are: 0.185, 0.264, and 0.156 ppm for OUs 1, 3, and 4, respectively. Thus, the Alternative C2 for OU 1 is significantly more protective than the API Panel's capping plan. An analysis estimating time for removal of fish advisories after capping was not presented, but would be longer than the recommended alternative, since the API Panel proposes to leave untreated a significantly greater amount of material than the Proposed Plan.

2) The API Panel's assumption that dredging will be limited by wastewater discharge requirements is incorrect. The analysis undertaken by WDNR demonstrates that there are no limitations as described by the API Panel. Given this, the API Panel's premise that capping will be a more readily achieved remedial option is invalid.

3) It appears that the API Panel's analysis assumes a 2 ppm residual concentration for dredged areas, and thus the API Panel concludes dredging would yield a less protective result than their capping proposal. However the 2 ppm residual concentration estimate is erroneous. Appendix B of the FS showed an average 97 percent concentration reduction for five dredging projects. Additionally, the Hudson River White Paper (*Post-Dredging PCB Residuals [ID 312663]*) showed dredging residual concentrations 96 to 98 percent (for nine projects evaluated). Thus, based on results from these dredging projects a 96 percent contaminant concentration reduction for residual sediments is reasonable, which provides an estimate for residual PCB concentrations much less than 1 ppm. The FS (and Proposed Plan) assumed a conservative 1 ppm for dredged areas. Incidentally, one of these projects was the Lower Fox River SMU 56/57 dredging project which had a 96 percent concentration reduction – pre-dredging PCB concentrations were 50 ppm and post-dredging concentrations 2 ppm. Presumably the 2 ppm assumption by the API Panel for dredging residuals appears to be based on the absolute concentrations remaining after dredging was completed at the SMU 56/57 project. However, this does not consider the proportional reduction observed consistently on this and other dredging projects, discussed above.

4) The API Panel's discussion regarding the permanence of a cap did not consider the modification of River hydraulics because of the placement of 1 foot of capping material in the River. This would reduce the River's cross-sectional area, and therefore increase water flow velocities and potential scour. The calculations for resuspension

of capping materials also do not consider mass movement processes – that is, movement of sediments as a slurry or by siltation processes. In other words, capping material could be disrupted without necessarily being resuspended.

5) Finally, greater potential (especially long-term) for erosion due to lower lake levels anticipated in the Great Lakes due to global warming was not considered. Lower lake levels are already occurring, and expert climatologists estimate a lower Lake Michigan lake level of 1.5 to 3 feet over the next three decades and up to 8 feet by the end of this century (see attached *Executive Summary and Report Cover for the Report of the Great Lakes Regional Assessment Group, U.S. Global Change Research Program, Great Lakes Overview*, October 2000). This report also predicts a likelihood for greater variability and severity of storm (e.g., flooding) events.

5.5.2 P.H. Glatfelter and WTMI

Master Comment 5.68

Alternative proposals to the Proposed Plan for remediation in OU 1 were offered by two of the PRPs on OU 1; P.H. Glatfelter and WTMI (formerly Wisconsin Tissue). Both proposals appear to have been developed in tandem, and with consideration of the report produced by the API Panel Report (The Johnson Company, 2002). The central tenant for their proposal is that active remediation is only required for Deposits A/B, and portions of Deposit POG. Active remediation would include only a partial removal of the contaminated sediments at the two deposits at an action level of PCBs greater than10 ppm, and covering the residuals with a sand cap. The companies argue that OU 1 sediments are stable, and that natural attenuation is occurring at Deposit E. Therefore, they contend that active remediation for the remainder of OU 1 is not required.

Response

The alternate remedial alternatives proposed for OU 1 do not meet the risk reduction and technical requirements of the proposed remedy. The findings are presented in detail in *White Paper No. 5C – Evaluation of Remedial Alternatives for Little Lake Butte des Morts Proposed by WTMI and P.H. Glatfelter*. The Agencies do not agree with the commenters' position that large portions of Little Lake Butte des Morts will not be subject to significant scour potential in perpetuity. Therefore, remediation must be included for all the deposits in OU 1 with exceedances of the 1 ppm RAL. More specifically, the Agencies find the following:

Risk Reduction

The alternative proposal submitted by P.H. Glatfelter and WTMI does not meet the risk reduction goals set by WDNR and EPA. As discussed in the Proposed Plan, management of the PCB-contaminated sediments within the 1 ppm RAL will result in the target SWAC of 0.19 ppm in the OU. The resulting SWAC from the combined P.H. Glatfelter/WTMI proposal is 1.7 ppm, essentially an order of magnitude greater than that targeted by the remediation agencies. Essentially, the alternative proposes an RAL of greater than 10 ppm to achieve a SWAC of 1.7 ppm.

Natural Attenuation

The P.H. Glatfelter/WTMI proposal relies on natural attenuation in the largest surface area of PCBs exceeding the RAL in OU 1: Deposit E. In the review of the more recent sediment data submitted by P.H. Glatfelter and WTMI (*White Paper No. 2 – Evaluation of New Little Lake Butte des Morts PCB Sediment Samples*), it was concluded that these newer data generally support the conclusion of the RI/FS and the Proposed Plan. Surface sediments within Little Lake Butte des Morts exceed the RAL of 1 ppm, and do not substantively alter the current SWAC for OU 1. The Agencies believe that these data, along with the TTA of sediment and fish tissue concentration do not support a natural attenuation alternative for Deposit E.

Technical Considerations

Both proposals are technically implementable. It is feasible to remove the contaminated sediments within Deposits A and POG, and replace the removed sediment with a cap. However, both proposals rely on the cap thickness and design estimates provided by the Panel Report, without presenting an evaluation of post-dredge conditions. As noted in *White Paper No. 6A – Comments on the API Panel Report*, a deficit of the API Panel capping proposal is that the API Panel did not present the rationale in selecting total cap thickness, the basis of design for the chemical isolation component, consolidation-induced advection, potential mixing of contaminated sediments and cap material, or constraints on capping in shallow-water areas. There is no basis to support an engineering design for the 6-inch cap proposed by P.H. Glatfelter and WTMI on bedded sediments, much less on sediments that have been disturbed by dredging. According to Dr. Palermo’s professional judgment, even a total cap thickness of 12 inches seems non-conservative for a major site like the Lower Fox River.

Institutional and Regulatory Considerations

The proposal by P.H. Glatfelter/WTMI does not provide a discussion of any of the institutional or regulatory considerations that are discussed in the *White Paper No. 6B – In-Situ Capping as a Remedy Component for the Lower Fox River*. This includes determining subaqueous property rights (i.e., Lake Bed

Grant or riparian owner easement), Wisconsin statutes that regulate “fills” in the Lake Winnebago pool system (Wis. Statute 30.203), federal and state prohibitions regarding fills within a navigation channel, floodplain zoning issues under WAC NR 116, long-term operations and maintenance, as well as mechanisms for long-term fiduciary responsibility.

Summary

The Agencies were unable to include these proposals in the final decision because they were not sufficiently protective or not implementable. However, the Agencies have included in the ROD a capping contingency as well as a post-dredging sand cover as an option. This flexibility in the final remedy is, in part, in response to comments and/or concerns expressed associated with these proposals.

5.5.3 Minergy/Earth Tech and Brennan

Master Comment 5.69

Three companies, Minergy Corporation, Earth Tech, and Brennan, submitted a conceptual design for the dredging and dewatering of the contaminated sediment above the 1 ppm RAL consistent with the proposed remedy, and then using vitrification (via GFT) for final sediment disposition instead of landfilling the dewatered sediments.

Response

WDNR and EPA appreciate the time and effort these companies have clearly put into their conceptual design. However, remedy design and implementation are beyond the scope of the FS, the Proposed Plan, or the ROD. These issues are typically addressed in the remedy design and remedial action (RD/RA) phase of a Superfund project. The WDNR will try to see that these ideas are included in the design phase of this project.

5.5.4 AquaBlock™

Master Comment 5.70

One commenter suggested that the capping alternative should consider the use of the clay-based AquaBlock™ sediment capping technology either as a replacement for or in concert with the granular sand capping materials currently being considered. In general terms, the commenter expected that the estimated material and placement costs associated with implementing a typical AquaBlock™ cap would be comparable to costs associated with implementing the preliminary cap design contained in the FS.

Response

Many of the capping issues presented in *White Paper No. 6B – In-Situ Capping as a Remedy Component for the Lower Fox River* would also have to be addressed for the use of this material to be used in the final remedy. This technology has not been proven for long-term effectiveness, particularly in a riverine environment. Of particular concern for application to the Lower Fox River is the generation of significant amounts of methane that could disrupt the integrity of a cap constructed from this material. The selection of capping material will be addressed during the final design of the remedy, should capping be included in the ROD.

6 Modeling Development and Application

6.1 Model Documentation Report

Master Comment 6.1

Several commenters suggested that modeling assumptions made by WDNR were not adequately described and therefore the selection of the proposed remedy was arbitrary and capricious due to insufficient model documentation.

Response

WDNR and EPA strongly disagree with this comment. There is an extensive body of information that has been developed related to fate, transport, and biological uptake of PCBs within the Lower Fox River and Green Bay. This body of information is carefully documented within the *Model Documentation Report* (MDR) and the supporting appendices. The MDR contains a comprehensive listing of all equations, assumptions, calibration procedures, and model code. In addition to the two-volume set, the MDR also includes CDs containing the working models, and all input and output files from all of the model runs performed as part of the RI/FS. The Agencies believe that the MDR provides a complete, open, and transparent set of documentation to the modeling process.

The models used within the RI/FS have been developed over multiple years as a collaborative process that included scientists and mathematicians within the Agencies, and scientists in both the public sector and the FRG. The model process was reviewed thoroughly and broadly. This included input from the USGS, USFWS, USACE, and researchers and scientists from the University of Wisconsin, University of Connecticut, and Manhattan College. The models received peer review by a panel assembled by the EPA, as well as an independent panel assembled by the American Geological Institute (AGI).

The process to evaluate models used in the Lower Fox River and Green Bay RI, BLRA, and FS were established through an agreement between the WDNR and the FRG in January 1997. The agreement established a model evaluation process (MEP) described in the *Work Plan to Evaluate the Fate and Transport Models for the Fox River and Green Bay* (Work Plan). A total of 17 separate technical memos were developed as part of the process and are provided as appendices to the MDR.

The purpose of the modeling effort was to improve the estimation and forecast of the movement of sediments contaminated by PCBs in the River and Bay, and the MDR provides a concise compilation of the models used in the RI/FS.

Models were just one tool used in the RI, BLRA, and FS to evaluate the degree and extent of contamination, risks to human health and the environment, and long-term benefits of implementing remedial approaches for the Lower Fox River and Green Bay study area. Information on other tools can be found in *White Paper No. 9 – Remedial Decision-Making in the Lower Fox River/Green Bay Remedial Investigation, Feasibility Study, and Proposed Remedial Action Plan*.

The process to evaluate model use in the Lower Fox River and Green Bay was established through an agreement between the WDNR and the FRG in January 1997. The agreement established an MEP described in the Work Plan. The Work Plan and technical memorandum prepared as part of the MEP are described in Section 2 of the MDR. The modeling effort conducted consisted of five interrelated programs to simulate the movement of PCBs in the environment:

- Lower Fox River and Green Bay interpolated bed maps that define sediment thickness, physical properties (e.g., TOC, bulk density), and total PCB concentrations;
- Whole Lower Fox River Model (wLFRM) used to simulate the movement of PCBs in the water column and sediment of the Lower Fox River from Little Lake Butte des Morts to the mouth of the River at Green Bay;
- Fox River Food Chain Model (FRFood) used to simulate the uptake and accumulation of PCBs in the aquatic food chain in the Lower Fox River based on the model results from wLFRM;
- Enhanced Green Bay PCB Transport Model (GBTOXe) used to simulate the movement of PCBs in the water column and sediment of Green Bay from the mouth of the Lower Fox River to Lake Michigan, including loading rates to Green Bay based on model results from wLFRM; and
- Green Bay Food Chain Model (GBFood) used to simulate the uptake and accumulation of PCBs in the aquatic food chain in the lowest reach of the Lower Fox River and in Green Bay.

These computer models were used to project changes in total PCBs in water, sediment, and fish over time. These models are mathematical representations of transport and transfer of PCBs between the sediments, water, and uptake into the food webs described in Section 3 of the FS.

The relationship between the models, their projected output, and how the output is used in evaluating risks, is described in the MDR. The bed maps produced as part of the RI are the foundation of the modeling inputs. The surface sediment total PCB concentrations for the baseline and action levels discussed in Section 5 of the FS are used as the inputs to both hydrodynamic models: the wLFRM and GBTOXe. These two models project total PCB concentrations in water and sediment. The output from the two transport models are used by the bioaccumulation models: FRFood and GBFood to project whole fish tissue concentrations of PCBs. The output from all of the models is then compared to the RALs specified in the FS.

Together, these models provided a method for evaluating the long-term effect on PCB concentrations in water, sediment, and aquatic biota under different remedial alternatives in the Lower Fox River and Green Bay. Alternatives were based on the removal of PCB-contaminated sediment above different action levels. By changing the initial PCB concentration in sediment such that all remaining sediments are below an action level, the models were then used to predict PCB concentrations in the aquatic environment over the next 100 years. The model results and conclusions from the model effort are discussed in the FS.

The MDR also describes how WDNR responded to issues raised through a model peer review conducted by the AGI. The panel prepared a report, which included a number of comments on the existing Lower Fox River models and recommendations for improving the model frameworks and conducting more robust and defensible modeling efforts. WDNR modified its model development effort to address many of the AGI concerns and modifications were made in response to many of the comments.

To complete the documentation, attached to the MDR are the complete set of finalized technical memoranda, the full detailed model documentation reports and user manuals, and a CD-ROM containing a working copy of each model, along with the input and output files for each model run. The Agencies believe that the model process is more than adequately documented. The Agencies also note that no other model offered for the Lower Fox River or Green Bay has a similar level of documentation.

Master Comment 6.2

Commenters stated that the remedy in the Proposed Plan relied on *Technical Memorandum 2g* (TM2g) of the MDR to describe sediment bed elevation and scour throughout the site; when in fact, that document relies almost entirely on data from OU 4. The commenters state that more recently collected data from OU 1 suggest that the area is depositional and that natural attenuation is occurring.

Response

WDNR and EPA agree that some statements concerning suspension and scour of sediments throughout the River may be too general and not as valid for Little Lake Butte des Morts as for the lower segments of the River. For example, Section 5.3 of the Proposed Plan, was written as an attempt to summarize the hydrodynamic characteristics of the Lower Fox River, with its principal point being that the sediments, in general, are dynamic and do not function in discrete layers. Discussion of the work of TM2g was included to add credence to the generalized statement that "scouring of the sediment bed plays a significant role in the quantity of sediment and contaminants transported through the river system." To avoid confusion, any future use of this information will clarify the locational specifics of the TM2g study.

However, the Agencies do not agree that that OU 1 is a "stable environment." While hydrographic surveys have not been performed in Little Lake Butte des Morts in recent years, site-specific data and other evidence of the dynamic nature of sediment bed conditions in OU 1 exist. In a recent study of short-term sediment deposition and resuspension in the Lower Fox River, Fitzgerald et al. (2001) collected Beryllium-7 (Be-7) samples from Deposit A in OU 1 and found that short-term sediment transport rates were up to 130 times larger than long-term net burial rates computed from Cesium-137 (Cs-137). Those authors conclude that the large difference between short-term and long-term accumulation rates in the Lower Fox River (including OU 1) suggests an extremely dynamic environment, even within an impounded river system.

Additional information also suggests that OU 1 is a dynamic environment. Estimated sediment trap efficiencies for this reach are approximately 10 percent, corresponding to long-term net burial rates of roughly 0.3 cm/yr, as reported in the wLFRM report in the MDR. Further, PCB concentrations in sediment samples recently collected from OU 1 include surface values much larger than previously reported for this reach, exceeding 360 ppm. Finally, the slow nature of net burial and the dynamic nature of sediment transport in OU 1 is demonstrated by the slow rate of natural recovery for this reach. More than 25 years after the virtual elimination of PCB discharges to OU 1, PCB concentrations in water and sediment remain at unacceptably high levels. This information is consistent with the findings reported by Fitzgerald et al. (2002) and suggests that rapid natural recovery is not occurring in OU 1.

Finally, citing the more recently collected data in OU 1 as "evidence" of the depositional nature of Little Lake Butte des Morts is not supported by a careful examination of the available information. *White Paper No. 2 – Evaluation of New Little Lake Butte des Morts PCB Sediment Samples* shows that there has been very little change in PCB sediment concentration. The recent data show higher concentrations in Deposits A and POG than have previously been measured. When re-estimated using the newer data, the

SWAC was essentially equivalent to that calculated from earlier data. Regardless of the suggestion that there is an overall depositional nature of OU 1, there are areas where surface sediment concentrations have not decreased over the study period (Deposit A and portions of Deposit POG).

Reference

Fitzgerald, S., J. Valklump, P.W. Swarzenski, R.A. MacKenzie, and K. D. Richards. 2001. Beryllium-7 as a Tracer of Short-Term Sediment Deposition and Resuspension in the Fox River, Wisconsin. Environ. Sci. Technol. 35:300-305

6.2 wLFRM

6.2.1 Adequacy of wLFRM

Master Comment 6.3

Several commenters stated that the computer modeling supporting the RI/FS and Proposed Plan's analysis is flawed. Specifically citing the wLFRM, these commenters argued that the wLFRM: (1) does not appropriately track sediment PCB concentrations over the calibration period, (2) overstates the shear stress and amount of resuspension, (3) does not account for releases of PCBs during dredging, and (4) does not account for residual PCB concentrations post-dredging. Identifying these issues as "fundamental flaws," they argue the wLFRM cannot accurately predict future conditions and should not be used to make remedial decisions.

Response

The commenters incorrectly imply that the wLFRM, or any model, was used solely to make remedial decisions. WDNR and EPA agree that no model can predict future conditions with a high degree of accuracy. As such, models were only one component of the remedial decision process, and were only used to help compare the relative differences between the various alternatives and action levels described in the FS.

White Paper No. 9 – Remedial Decision-Making in the Lower Fox River/Green Bay Remedial Investigation, Feasibility Study, and Proposed Remedial Action Plan describes how information from many different sources and supporting studies identified the need to implement an active remediation strategy for the Lower Fox River and Green Bay. No single source of information or study findings in and of itself leads to selection of a remedy. The combined findings of numerous supporting studies provides the clear weight of evidence that supports selection of the remedy. These findings and decision-making process are consistent with the three groupings of the EPA NCP nine CERCLA criteria as follows:

Threshold Criteria

- Risks to human health and the ecosystem are unacceptable. Natural recovery has not effectively reduced risks in the 30-plus years timeframe since the cessation of the manufacturing and recycling of PCB-contaminated carbonless copy paper has ceased.

- WDNR and EPA objectives are to eliminate consumption advisories for recreational anglers within 10 years of completion of remediation and within 30 years for high-intake fish consumers.

- Natural dechlorination is not effective as a remedial alternative in the Lower Fox River. Dechlorination is limited to concentrations that are greater than 30 ppm, which exceeds the selected 1 ppm RAL.

- Natural attenuation, as evidenced by changes in sediment and fish tissue concentrations of PCBs over time, is not proceeding at a rate that would result in achievement of the Agencies' risk reduction goals.

- Comparative modeling shows that active remediation will result in risk reduction more quickly than either the MNR or no action alternatives and will achieve risk reduction objectives for certain fish species.

- This work can be completed while complying with ARARs of state and federal rules.

Balancing Criteria

- There are large amounts of PCBs and contaminated sediment in the Lower Fox River. Much of this sediment is found in the top 100 cm of the sediment bed that can be managed by dredging.

- The sediment bed in the River is dynamic, resulting in resuspension and downstream transport of PCBs in the water column.

- Removal alternatives can achieve both short-term (e.g., remove to specific elevation or concentration, minimal resuspension of contaminated sediment) as well as long-term goals (e.g., removal of fish consumption advisories).

- An effective post-remediation monitoring program is needed to ensure and measure the effectiveness of any remedial action.

Regulatory/Community Criteria

- WDNR and EPA have worked together on the selection of this remedy and both are in agreement with the selection for OUs 1 and 2.

- WDNR and EPA have taken many steps to inform the public of the work being conducted on the Lower Fox River and Green Bay and have used that input in preparing documents.

- Comments submitted by the public have been considered in the selection of this remedy for OUs 1 and 2. The responses to comments received during the public comment period are included in this RS.

With regards to the technical concerns raised by commenters, these are responded to in the Master Comments, below.

6.2.2 Calibration Issues

Master Comment 6.4

Several commenters stated that the computer modeling supporting the RI/FS and Proposed Plan's analysis is inadequate for decision making. Specifically citing the wLFRM, these commenters argued that the wLFRM does not appropriately track sediment PCB concentrations over the calibration period. The commenters presented a figure that shows the forecasted sediment PCB concentrations over time for the Proposed Plan's natural attenuation or "No Action" scenario. Surface sediment PCB concentrations, they contend, are predicted to increase sharply during the first 5 years of the forecast, level off for 5 years, and then decline at a very slow rate. As a result of this surface sediment increase, they maintain that the wLFRM predicts that PCB surface concentrations will "bump up" and remain above current conditions for more than 40 years.

Response

WDNR and EPA believe that the wLFRM is the appropriate transport model to use, in conjunction with the other tools cited in Master Comment 6.3. With respect to the ability of the wLFRM to appropriately track sediment PCB concentrations during the calibration period, *White Paper No. 16 – wLFRM Development and Calibration for the Lower Fox River/Green Bay Remedial Investigation, Feasibility Study and Proposed Remedial Action Plan* noted that simulated reach averaged surface sediment PCB levels in the wLFRM fall within, and never exceed, the 95 percent confidence intervals of observed PCB levels. Considering the area between the De Pere dam and the River mouth (OU 4), the upper 95 percent confidence limit of the observations is more than 60 percent larger than the average. Model results for OU 4 never exceed the 95 percent confidence limit of observed PCB levels for this reach. The small (~1 ppm) difference in model results over time is more a reflection of the spatial heterogeneity of the observations rather than any failure of the model to appropriately track surface sediment PCB levels.

It is also important to note that the commenter's concern regarding the ability of the model to track PCB levels is based on the incorrect premise that PCB concentrations in sediments can never increase over time. At any location where PCB levels immediately below the surface-most sediments exceed the PCB levels found in surface sediment, the possibility for PCB increases exists. Any time bed elevation decreases occur at that location, the average PCB concentration in the top 10 cm of sediments will increase. As demonstrated by TM2g (WDNR, 1999) and follow-up efforts, such decreases in sediment bed elevations are common in the Lower Fox River. Given that wLFRM performance falls within the 95 percent confidence limit of the observations and that sediment bed elevations decreases do occur and may cause PCB levels in surface sediments to increase, WDNR and EPA believe that claims suggesting the wLFRM does not appropriately track sediment PCB levels are unsupported.

Further, it must be recognized that the main pathway for risk in the Lower Fox River is PCB exposure via the water column. As part of model calibration, both the water column and sediment bed were considered. Once model results for both the water column and sediment bed met the model performance criteria established in Technical Memorandum 1, the model calibration was considered acceptable. Despite the greater uncertainty of model results for the sediment column, model performance for sediment PCB levels is nonetheless acceptable. More importantly, model performance for the central risk pathway, water column PCB exposures, is quite good. Again, in light of all these factors, WDNR and EPA believe that claims suggesting the wLFRM does not appropriately track sediment PCB levels are unsupported.

Reference

WDNR, 1999. *Technical Memorandum 2g: Quantification of Lower Fox River Sediment Bed Elevation Dynamics through Direct Observations*. Wisconsin Department of Natural Resources, Madison, Wisconsin. July 23.

Master Comment 6.5

Commenters argued that model's prediction of PCB sediment concentrations under the "no action" alternatives does not reflect the strong and continuing downward trend shown by actual sediment data. They contend that, as a result, the model underestimates the degree to which natural attenuation is taking place.

Response

The claim that a strong and continuing downward trends in Lower Fox River sediment PCB levels exist is not supported by observations. Surface sediment PCB concentration trends were examined in two different supporting studies as part of the RI/FS. As documented by Appendix B of the MDR (the wLFRM report), there is no clear trend. At different locations, surface sediment PCB levels appear to increase, decrease, or stay the same. Similar findings were also reported by The Mountain-Whisper-Light Statistical Consulting (TMWL) (Appendix B of the RI). The wLFRM report in the MDR describes four conclusions that may be drawn from these data: (1) a spatial trend of generally decreasing sediment PCB concentration with distance from Lake Winnebago exists; (2) apparent PCB concentration changes over time may reflect the spatial heterogeneity of PCBs in the sediments; (3) at any individual location, sediment PCB concentrations may increase, decrease, or stay the same over time; and (4) the overall rate at which surface sediment PCB concentrations change over time is slow.

The Agencies further note that the commenters relied on inappropriate combinations of data to provide their analysis of "strong downward trends." Over time, data were collected at different locations, from different strata, and using different sample collection and analytical protocols. In addition, post-GBMBS sampling efforts often had biased objectives as reflected in at least two data collection activities at Deposit A where the objective was to delineate the extreme edges of the deposit. Biases introduced as a result of these methodological differences are more than large enough to account for any trends the commenters inferred. A brief discussion of these biases is provided by in the MDR (Appendix A).

6.2.3 Sediment Bed Dynamics in OU 1 versus OU 4

Master Comment 6.6

Commenters claimed that the FS and Proposed Plan rely on studies of sediment bed dynamics in OU 4, and not OU 1 was cited by some commenters as a deficiency in those documents. The commenters argue that site-specific data indicate that Little Lake Butte des Morts' sediment bed is stable, not dynamic as suggested TM2g. The MDR and the Proposed Plan chose not to include or discuss TM5d, and chose to represent Little Lake Butte des Morts as a dynamic system.

Response

Like all supporting studies, the results of TM5d were considered during development of the wLFRM, as well as the RI/FS and Proposed Plan. Note that TM5d was a modeling study of sediment transport in Reaches 1 through 3 of the River. As part of TM5d development, numerous assumptions were made regarding the nature and grain size distribution of solids entering the River from Lake Winnebago. As noted in Appendix A of the MDR, TM5d and wLFRM results are sensitive to the grain size distribution of the upstream boundary condition and that the uncertainty associated with the grain size distribution of the upstream solids boundary condition is significant. Further discussion of this point is provided in Section 3.5.1 of Appendix A of the MDR.

As discussed in Master Comment 6.2, site-specific data and other evidence of the dynamic nature of sediment bed conditions in OU 1 exists. In a recent study of short-term sediment deposition and resuspension in the Lower Fox River, Fitzgerald et al. (2001) concluded that the large difference between short-term and long-term accumulation rates in the Lower Fox River (including OU 1) suggests an extremely dynamic environment, even within an impounded river system.

Additional information also suggests that OU 1 is a dynamic environment. Estimated sediment trap efficiencies for this reach are approximately 10 percent, corresponding to long-term net burial rates of roughly 0.3 cm/yr. Further, PCB concentrations in sediment samples recently collected from OU 1 include surface values much larger than previously reported for this reach; as high as 360 ppm. Finally, the slow nature of net burial and the dynamic nature of sediment transport in OU 1 is demonstrated by the slow rate of natural recovery for this reach. More than 25 years after the elimination of PCB discharges to OU 1, PCB concentrations in water and sediment remain at unacceptably high levels. This information is consistent with the findings reported by Fitzgerald et al. (2001) and suggests that rapid natural recovery is not occurring in OU 1.

Given the recent findings of very high surface sediment PCB concentrations in OU 1 as well as the site-specific findings of Fitzgerald et al. (2001), WDNR and EPA believe the claim that the sediment bed of OU 1 is uniformly and consistently stable are unfounded.

Reference

Fitzgerald, S. A., J. Val Klump, P. W. Swarzenski, R. A. Mackenzie, and K. D. Richards, 2001. Beryllium-7 as a tracer of short-term sediment deposition and resuspension in the Fox River, Wisconsin. United States Geological Survey. *Environmental Science & Technology*. 35:300–305.

Master Comment 6.7

Commenters stated that the wLFRM predicts steady erosion in roughly 20 sediment bed segments in the center navigation channel of the River below the De Pere dam. For decades, it has been necessary for the USACE to dredge this navigation channel to keep the channel open for commercial traffic. Thus, they conclude that many of the specific areas that wLFRM assumes to be erosional are the same areas the USACE must dredge regularly to remove new deposits.

Reference

Fitzgerald, S., J. Valklump, P.W. Swarzenski, R.A. MacKenzie, and K. D. Richards. 2001. Beryllium-7 as a Tracer of Short-Term Sediment Deposition and Resuspension in the Fox River, Wisconsin. Environ. Sci. Technol. 35:300-305

Response

WDNR and EPA disagree with this comment. While observed bed elevations are more dynamic than wLFRM results (or the results of any sediment transport model developed for the site), the model typically represents the direction of bed elevations changes over time as shown in Table 4-5 of the wLFRM report in the MDR.

However, it is important to note that this comment misrepresents the extent of dredging and locations where dredging has occurred in the Lower Fox River over the past 30 years. The only areas where dredging has routinely occurred are the Fort James (Georgia Pacific) and East River turning basins. As documented in TM2g, much of the navigation channel has not been dredged in 30 years. Of those few locations where dredging has occurred, many of those areas have been dredged once. The reason that dredging has not occurred in much of the navigation channel is because sediment bed elevations have either been relatively constant or have decreased over time.

Given that dredging in the navigation channel has been quite limited over the past 30 years, that bed elevations in some areas of the navigation channel have decreases over time, and the ability of the model to represent the direction of bed elevation changes over time, WDNR and EPA believe this comment is unfounded.

6.2.4 ECOM-SED/Technical Memorandum 5d versus Technical Memorandum 2g

Master Comment 6.8

The shear stress and depth of scour used by wLFRM was questioned by some commenters. They argued that the ECOM-SED model and the RMA model predict substantially lower shear stress and depth of scour near the banks of the River.

Response

This comment overstates the differences between hydrodynamic model results and conditions in the wLFRM. The wLFRM uses flow-velocity relationships developed from the results of hydrodynamics models to estimate shear stresses and erosional amounts (from which depth of scour is estimated).

These flow-velocity relationships relate average hydrodynamic velocities over the surface area of each sediment deposit, interdeposit area, and sediment management unit (SMU) to the average flow. The average value used in the wLFRM will represent the average hydrodynamic value that occurs over any sediment area. It is therefore important to recognize that the hydrodynamic models and the wLFRM have different spatial scales. Within any wLFRM segment, hydrodynamic model results can be somewhat larger or smaller than the average value. However, when hydrodynamic model grid cells within a given wLFRM segment are appropriately averaged, there is a direct correspondence between the hydrodynamic model results and the wLFRM.

To make long-term simulations computationally feasible, the wLFRM was developed with a coarser spatial scale than ECOM-SED. ECOM-SED grid cells are much smaller (~60 meters by 90 meters) than those needed to develop the wLFRM (~400 meters by 1,000 meters). ECOM-SED results were averaged over wLFRM water column segments to produce a relationship between velocity and average flow. Averaging is also necessary because: (1) flow is the only parameter for which a long-term record exists from which velocity can be estimated; and (2) the long-term flow observations (1954–1995) include conditions which did not occur during the ECOM-SED (TM5b, TM5c) 1989–1995 calibration period. As a result of spatial averaging, some fine-scale detail is lost. However, average velocities are preserved. By definition of an average quantity, for each case where the velocities at individual ECOM-SED grid cells are less than the average velocity of a wLFRM segment, there are an equal number of locations where velocities at ECOM-SED grid cells exceed the wLFRM average velocity. Perhaps more importantly, it is worth noting that the purpose of the wLFRM was to provide insight into the relative trends and magnitudes of PCB concentrations over time on a reach-by-reach basis. For this spatial (and temporal) scale, use of average velocity values is very reasonable. Proposed remedial strategies are provided on a reach-by-reach basis. Management of contaminated areas on a 60-meter by 90-meter scale is impracticable. Even if remediation on such a fine scale were practicable, preservation of ECOM-SED (or RMA) results at the full spatial (and temporal) resolution of the two-dimensional hydrodynamic model is of questionable value. The flow structure of a natural system is three-dimensional as secondary and helicoidal flows and other conditions occur. Vertically averaged, two-dimensional hydrodynamics models do not resolve such flow features (see Lane et al., 1999). Under such conditions, retaining the full precision of a two-dimensional hydrodynamic approximation provides no additional accuracy. In essence, representing an approximation with more significant figures does not improve the accuracy of the approximation.

Reference

Lane, S.N., K.F. Bradbrook, K.S. Richards, P.A. Biron, A.G. Roy. 1999. The application of computational fluid dynamics to natural river channels: three-dimensional versus two-dimensional approaches. Geomorphology 29: 1–20

6.2.5 Depth of Mixing

Master Comment 6.9

Commenters stated that the wLFRM improperly uses a mixing depth of 30 cm, and should instead use a 10-cm mixing depth. They further maintain that the draft MDR dated October 2001 does not provide any justification for the assumption of a 30-cm mixing depth and argue that the literature “standard” for mixing is 10 cm.

Response

Mixing depths used in the wLFRM are well supported by field data. Observed sediment mixing depths vary widely. While typical mixing depths range from 10 to 30 cm, sediment disturbances of up to 200 cm have been observed. It should be noted that this comment asserts that a “standard” sediment mixing depth exists. This assertion is based on the incorrect premise that mixing is almost exclusively driven by biological processes and other processes do not disturb the sediment bed. However, contrary to this premise, other processes such as bed elevation changes due to flow events, density currents, methane flux, and sediment slumping can also disturb and mix sediments.

As described in TM2g and follow-up efforts (WDNR, 2001), sediment bed elevations in the Lower Fox River are very dynamic. Over monthly to annual times scales, sediment bed elevations have been observed to regularly fluctuate between 10 to 30 cm. Larger fluctuations of approximately 200 cm have also been recorded over annual time scales. Over broad areas, the net change in bed elevation is very small. This means that at each location where a large decrease in bed elevation occurs, there is typically a nearby location with a correspondingly large increase in elevation. Consequently, within the same general area there is a pattern of mixing where particles and contaminants located deeper within the sediment column can return to the sediment surface and materials initially at the surface are buried until the next disturbance occurs.

In addition to bed elevation data, the periodic disturbance of sediments to considerable depth in the sediment column is supported by the Cesium-137 (Cs-137) profile results reported by Steuer et al. (1995) that show sediment disturbances to depths of approximately 40 cm. It should also be noted that data provided by the comment documents mixing depths of up to 20 cm from locations where intact Cs-137 profiles could be obtained. Given the large number of observations that indicate sediment mixing depths are variable and that sediment disturbances of up 200 cm can occur, WDNR and EPA believe the claim that sediment mixing depths are limited to 10 cm is not defensible.

References

Steuer, J., S. Jaeger, and D. Patterson, 1995. *A Deterministic PCB Transport Model for the Lower Fox River Between Lake Winnebago and De Pere, Wisconsin*. Wisconsin Department of Natural Resources Green Bay and Madison, Wisconsin. 283 p.

WDNR, 2001. *Development and Application of a PCB Transport Model for the Lower Fox River*. Wisconsin Department of Natural Resources, Madison, Wisconsin. June 15.

Master Comment 6.10

Commenters stated that the wLFRM's segmentation of the sediment bed is flawed because initial segment thicknesses in the model vary from 5 cm at the surface to 50 cm at depth. As a result, the mixed depth of sediment increases significantly over time in some areas, exacerbating the effects of the 30-cm mixing depth error described above. They further argue that these uneven strata make the wLFRM incapable of accurately reflecting surface sediment concentrations when erosion occurs.

Response

The depth to which sediment mixing or other disturbances may occur is not constant and varies widely by location and over time. This is described in detail in Appendix A of the MDR. The most straightforward method to represent variability in the depths of sediment disturbances was the use of sediment segments that increase in thickness with depth below the sediment-water interface. By use of this segmentation approach, the sediment mixing depth in and sediment stack can vary in response to the extent of erosion or deposition that occurred. Areas subject to larger disturbances will take on a larger mixing depth and areas subject to less extensive disturbances will take on a smaller mixing depth. Given the observed extent and variability of sediment mixing depths as summarized in Appendix A of the MDR, in *White Paper 16 – wLFRM Development and Calibration for the Lower Fox River/Green Bay Remedial Investigation, Feasibility Study, Proposed Remedial Action Plan, and Record of Decision*, and LTI (2002), WDNR and EPA believe that mixing depths are appropriately represented in the wLFRM.

Reference

LTI, 2002. Measurement of Burial Rates and Mixing Depths Using High Resolution Radioisotope Cores in the Lower Fox River. In: *Comments of the Fox River Group on the Wisconsin Department of Natural Resources' Draft Remedial Investigation, Draft Feasibility Study, Baseline Human Health and Ecological Risk Assessment, and Proposed Remedial Action Plan*. Appendix 10. Prepared by Limno-Tech, Inc., Ann Arbor, Michigan.

Master Comment 6.11

Commenters argued that application of the wLFRM results in an artificial buildup of PCB mass in the surface sediment layers.

Response

WDNR and EPA believe the commenters have misrepresented the nature of wLFRM results. With respect to the ability of the wLFRM to appropriately track sediment PCB concentrations during the calibration period, note that simulated reach averaged surface sediment PCB levels in the wLFRM fall within, and never exceed, the 95 percent confidence intervals of observed PCB levels. Considering the area between the De Pere dam and the River mouth (Reach 4), the upper 95 percent confidence limit of the observations is more than 60 percent larger than the average as previously noted. Model results for Reach 4 never exceed the 95 percent confidence limit of observed PCB levels for this reach. The small (~1 ppm) difference in model results over time, described as an "artificial buildup" by the commenters, is more a reflection of the spatial heterogeneity of the observations rather than any failure of the model to appropriately track surface sediment PCB levels. Because model results never fall outside this confidence limits of the initial condition, the proper interpretation of wLFRM results is that the model predicts little change in surface sediment PCB levels over time. Such a result and interpretation is consistent with the surface sediment PCB trends analyses presented in the RI/FS.

Perhaps more significantly, note that this comment regarding the ability of the a model to track PCB levels is based on the flawed premise that PCB levels in sediments can never increase over time. In contrast to this premise, not that at any location where PCB levels immediately below the surface-most sediments exceed the PCB levels found in surface sediment, the possibility for PCB increases exists. Any time bed elevation decreases occur at that location, the average PCB concentration in the top 10 cm of sediments will increase. As conclusively demonstrated by TM2g (WDNR, 1999) and follow-up efforts, such decreases in sediment bed elevations are common in the Lower Fox River. Given that wLFRM performance falls within the 95 percent confidence limit of the observations and that sediment bed elevations decreases do occur and may cause PCB levels in surface sediments to increase, WDNR and EPA believe that claims suggesting the wLFRM does not appropriately track sediment PCB levels are unsupported.

Further, it must again be recognized that the main pathway for risk in the Lower Fox River is PCB exposure via the water column. As part of model calibration, both the water column and sediment bed were considered. Once model results for both the water column and sediment bed met the model performance criteria established in Technical Memorandum 1 (LTI and WDNR, 1998), the model calibration was considered acceptable. Despite the greater uncertainty of model results for the sediment column, model performance for sediment PCB levels is nonetheless acceptable. More importantly, model performance for the central risk pathway, water column PCB exposures, is quite good. Again, in light of all these factors, WDNR and EPA believe that claims suggesting the wLFRM does not appropriately track sediment PCB levels are unsupported.

References

LTI and WDNR, *1998. Technical Memorandum 1: Model Evaluation Metrics*. Limno-Tech Inc., Ann Arbor, Michigan and Wisconsin Department of Natural Resources, Madison, Wisconsin. March 13.

WDNR, 1999. *Technical Memorandum 2g: Quantification of Lower Fox River Sediment Bed Elevation Dynamics through Direct Observations*. Wisconsin Department of Natural Resources, Madison, Wisconsin. July 23.

Master Comment 6.12

Commenters stated that the wLFRM does not adequately represent the relationship between sediment volumes and exchange areas in subsurface sediment layers. They content that this leads to greater rates of erosion in some areas.

Response

This comment is mischaracterizes the operation of the IPX 2.7.4 modeling framework and the performance of the wLFRM. Surface areas for all sediment layers in the wLFRM vary as determined from field data. As erosion and deposition occur during a simulation, the IPX 2.7.4 framework always uses the appropriate surface area of the sediment segment to compute the mass flux of material to or from each sediment segment. The IPX 2.7.4 framework appropriately manages sediment surface areas (and all other properties) regardless of whether erosion or deposition occurs in a segment. Management of sediment stack properties within IPX 2.7.4 is performed in Subroutines PUSH and POP. Sections 1.5.3.2 and 1.5.4.2 of the IPX 2.7.4 user’s manual (EPA, 2001) describe the operation of these subroutines. Further, examination of model source code for these two subroutines shows that sediment properties are appropriately managed. Therefore, comments that purport that the relationships between sediment segment volumes and surface areas are not properly represented in the wLFRM are not accurate.

Reference

EPA, 2001. *A User's Guide to IPX, the In-Place Pollutant Export Water Quality Modeling Framework, Version 2.7.4*. EPA/600/R-01/079. United States Environmental Protection Agency, Office of Research and Development, National Health and Environmental Effects Research Laboratory, Mid-Continent Ecology Division, Large Lakes Research Station, Grosse Ile, Michigan. 179 p.

6.2.6 Water Column/Pore Water

Master Comment 6.13

One commenter stated that the wLFRM does not include any modeling process to account for pore water diffusion.

Response

Porewater diffusion is one of the possible mass transfer pathways for PCBs in the sediments. This process is included in the conceptual model framework, and is discussed in *White Paper 16 – wLFRM Development and Calibration for the Lower Fox River/Green Bay Remedial Investigation, Feasibility Study, Proposed Remedial Action Plan, and Record of Decision*. Porewater transfers can move dissolved PCBs between sediment layers and to the water column. In the wLFRM, PCB porewater transfer functions were specified between layers in the sediment column. However, due to an oversight when the model input data files were constructed, the final linkage between the surface sediments and the water column was not specified. Note that porewater diffusion can only transport dissolved and bound phase PCBs. Also note that PCBs are strongly associated with particles because they are hydrophobic and that less than 1 percent of the PCBs in the sediments are expected to be associated with dissolved and bound phases. As a result, the impact of this oversight is expected to be very small.

6.2.7 Dredging Releases/Residuals

Master Comment 6.14

Commenters argued that the wLFRM should have accounted for dredging processes, including PCB remobilization during dredging, and residual PCB concentrations post-dredging. They note that the wLFRM modeling analysis did not include any PCB releases to the water column from dredging, which they contend results in overestimating removal relative to Monitored Natural

Recovery. In addition, they maintain that wLFRM should have explicitly accounted for post-dredging PCB sediment concentrations.

Response

Direct releases of PCBs can occur during dredging active operations. Such direct releases of PCBs were not explicitly included in the site-specific chemical transport and bioaccumulation models developed for the RI/FS. This model design factor was based on consideration of the scale of annual PCB mass transport through the River and the ability to control potential releases during dredging.

With respect to the representation of PCB releases during dredging, note the wLFRM represents remediation by a series of alternative-specific targets for post-remediation sediment bed elevations and PCB concentrations initially at depth in the sediment bed. The wLFRM does not explicitly simulate dredging. As discussed in *White Paper 9 – Remedial Decision-Making for the Lower Fox River/Green Bay Remedial Investigation, Feasibility Study, Proposed Remedial Action Plan, and Record of Decision*, PCB releases during dredging are expected to be very small relative to existing levels of PCB transport in the Lower Fox River. In particular, it should be noted that during the Deposit N and SMU 56/57 demonstration projects, the mass of PCBs released by dredging was roughly two orders of magnitude smaller (less than 1 percent) than the present level of ongoing PCB transport through the Lower Fox River. Assuming full-scale dredging operations were initiated, direct releases of PCBs during dredging (a few kilograms per year) would always be far smaller than natural transport rates (several hundred kilograms per year). Further, as documented by the *Sediment Technologies* supporting study of the RI/FS, direct PCB releases during dredging can be minimized by the use of careful controls during dredging. Given these observations, the effect of PCB releases during dredging and the impact of PCBs potentially present in post-dredge patina layers were considered negligible.

As for the incorporation of dredging releases into the water quality modeling, WDNR and EPA see little value in adding another variable into the models. Any differences between model results with or without the 2.2 percent dredging losses observed at SMU 56/57 are well within the uncertainty of the models, given that the acceptable threshold for model performance developed in cooperation with the FRG (*Model Evaluation Workgroup Technical Memorandum 1: Model Evaluation Metrics*). The acceptable level of performance defined in Technical Memorandum 1 is ±30 percent of observed concentrations.

With respect to the representation of residual surface sediment PCB concentrations immediately following dredging, note the wLFRM represents remediation by a series of alternative-specific targets for post-remediation sediment bed elevations and PCB concentrations. Patinas (thin residual layers) of more-highly PCB-contaminated sediments were not explicitly included in the wLFRM based on consideration of the ability of dredging technologies to achieve low residual PCB concentrations and the rapid rate at which conditions at the sediment-water interface are expected to change following dredging. In particular, as monitored following first phase of the SMU 56/57 demonstration project in 1999, PCB concentrations in portions of the dredged area where post-dredging bed elevation meet the target elevation were approximately equal to PCB concentrations initially present at that sediment depth (WDNR, 2000b). Further, post-dredging monitoring of the SMU 56/57 site showed that rapid changes in the sediment-water interface occurred over time and that conditions a few months following dredging did not resemble conditions immediately following dredging (WDNR, 2002a). Given these observations, the effect of PCB releases during dredging and the impact of PCBs potentially present in post-dredge patina layers were considered negligible.

References

WDNR, 2000a. *Addendum to Technical Memorandum 2e: Estimation of Sediment Bed Properties for the Lower Fox River (4 reach effort)*. Memorandum prepared by G. Fritz Statz. Wisconsin Department of Natural Resources, Madison, Wisconsin. October 26.

WDNR, 2000b. *Post-Dredging Results for SMU 56/57*. Memorandum prepared by Bob Paulson. Wisconsin Department of Natural Resources, Madison, Wisconsin. February 21.

6.3 FRFood

Master Comment 6.15

Commenters stated that the food web model used for the Lower Fox River (FRFood) does not accurately represent the bioaccumulation processes operating in the Lower Fox River. They state that FRFood was constructed using model parameters taken exclusively from scientific literature, with no attempt to determine whether those parameters were appropriate for the Lower Fox River system. They question the use of fillet to whole body ratios in the model development. As a result, they maintain that FRFood contains assumptions that are inconsistent with actual data collected from the Lower Fox River, and will not accurately predict the impact of remedial alternatives on fish tissue PCB concentrations in the Lower Fox River.

Response

WDNR and EPA disagree with comments implying that the FRFood model contains significant errors and/or incorrect parameterizations. This comment is based upon the review conducted on behalf of the FRG by Limno-Tech, Inc. (LTI), in an attachment to the FRG comments entitled *Evaluation of WDNR Fate and Transport and Food Web Models for the Lower Fox River/Green Bay System*. Issues relating to adequacy of the model, documentation, calibration, and growth rates are discussed below.

Adequacy of the Gobas Model

FRFood was based upon the algorithms developed originally by Gobas (1993). The Agencies believe that the robustness of the model and its applicability to the Lower Fox River is demonstrated by the successful use at other sites, including:

- The model was developed for Great Lakes food chains and has been previously validated using both Lake Ontario and Green Bay PCB and food web data.

- EPA made extensive use of the Gobas model to derive bioaccumulation factors, bioconcentration factors, and food chain multipliers in the development of the Great Lakes Water Quality Initiative (GLWQI) criteria (EPA, 1993, 1994).

- The Gobas model was used in the 1996 RI/FS for the Lower Fox River and found to yield reasonably good results between predicted and measured fish tissue PCB concentrations (GAS/SAIC, 1996).

- A modified version of the Gobas model was used for the Ecological Risk Assessment for the Sheboygan River, Wisconsin, and also found reasonable similarity between predicted and measured PCB levels in fish (EVS, 1998).

- The Gobas algorithms, as developed into the FISHRAND model, were used to project future PCB concentrations in fish for the Hudson River (EPA, 2000).

In fact, the Agencies note that most of the comments raised in the LTI report were the same as those raised, but successfully defended, for FISHRAND on the Hudson River.

FRFood Model Documentation

The Agencies believe that the underlying algorithm developed originally by Gobas (1993) are sufficiently robust to support the FS, and that documentation provided is more than adequate to have reconstructed the parameterization. The complaint that there was inadequate documentation to the model itself is inaccurate. Model algorithms were described in the *FRFood Model Documentation Memorandum* in as far as changes or modifications to the original Gobas (1993) were added to the version of FRFood that was developed in MS Access format. These are defined in Section 2 of the *FRFood Model Documentation Memorandum*. Furthermore, the entire FRFood model, along with all of the model runs conducted for the FS was provided on a CD-ROM. All of the information necessary to fully evaluate the model was provided to the public.

Calibration

Output from the FRFood model matched up very tightly with the observed fish tissue concentrations, both within the calibration period of 1989–1995, but also when projected out to the data collected in 1998. Both point projections, as well as projections by FRFood when coupled with the output from wLFRM were found to have excellent agreement with the observed data, contrary to the statements made by LTI.

A discussion of the FRFood model calibration was provided in the documentation, and in Section 7 of the BLRA. As described fully in that document, FRFood was first calibrated based upon point estimates; measured sediment and water concentrations within each reach were used as a basis for estimating fish tissue concentrations for multiple species. The model was parameterized for each reach and its specific food web, and calibration continued until model predictions matched measured fish tissue concentrations.

FRFood was then checked against the output from wLFRM, and from GBTOXe, and predicted concentrations for most of the fish species. For OUs 1 and 4, the combined FRFood/wLFRM output shows very good agreement with the observed data. As noted in the FRFood document, there is excellent correlation, especially for carp and walleye in OUs 1 and 4. Figures 3-3 and 3-5 from the memorandum are shown below (Figures 5 and 6). For example, in OU 4 the projected values were within 86 and 96 percent of the observed values, respectively, for those two species over the calibration period. When projected out to fish tissue concentrations observed in 1998, the wLFRM/FRFood projections were well within the observed data.

Figure 5 FRFood Calibration: Little Lake Butte des Morts

Fox River Food (FRFood) Model Documentation Memorandum

Figure 3-3 FRFood Calibration: Little Lake Butte des Morts
Predicted vs. Observed Total PCBs in Walleye and Carp
1989–1998

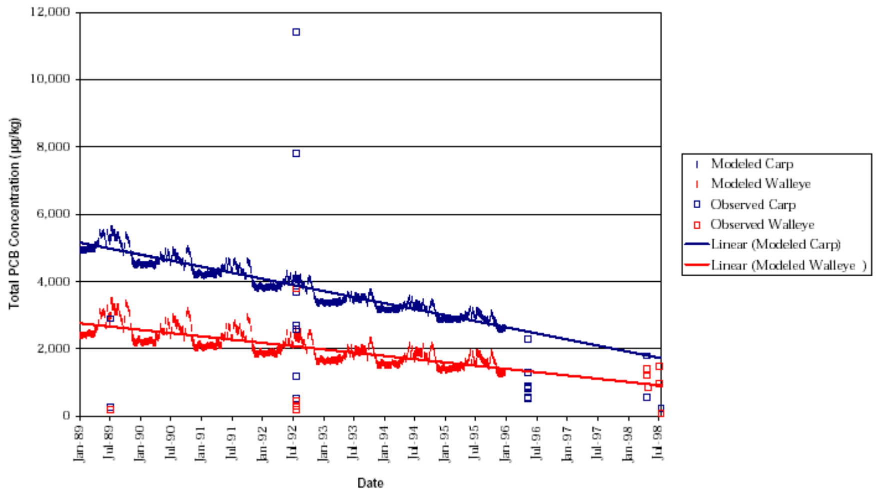


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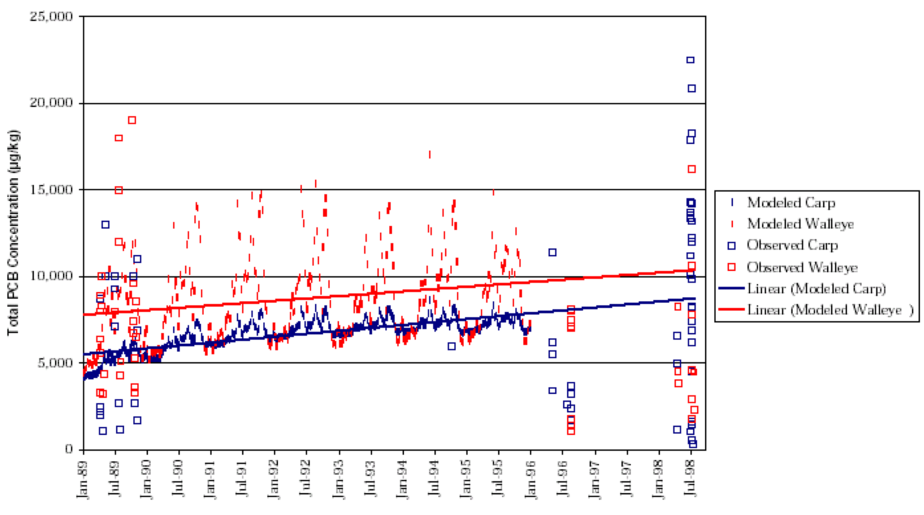
Figure 6 FRFood Calibration: De Pere to Green Bay Reach

Fox River Food (FRFood) Model Documentation Memorandum

Figure 3-5 FRFood Calibration: De Pere to Green Bay Reach
Predicted vs. Observed Total PCBs in Walleye and Carp
1989–1998



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Concerning the topic of fillet to whole body ratios. These were used to develop the SQTs for human health, and are discussed in Section 4. The ratios were not used in the calibration; their inclusion as a table in Section 3 is a minor error readily realized by reading the text.

Concerning whether graphics were "improperly" labeled; the commenter complained that they could not determine what the units were in graphics or tables. In all cases, as recorded in the text, units are displayed and report PCB concentrations based upon the wet weight of this fish.

Food Web and Prey Preference

The Agencies believe that the food web and prey preferences developed for FRFood are good representations of the bioaccumulation pathways in the Lower Fox River and Green Bay. The food web and prey preferences were developed in FRFood based upon site-specific information, and knowledge of similar species diets gained from scientific literature. Food web and prey preferences are documented in both *Technical Memorandum 7b* (Exponent, 1999) and *Technical Memorandum 7c* (TM7c) (WDNR, 2001). Both of those documents rely, in part, on the content analyses conducted by Magnuson and Smith (1987). Even the FRG's consultant noted that, "Site-specific stomach content data provide a solid foundation for determining predator diets in the Connolly et al. (1992) food web model" (Exponent, 1999). The food web, diets, and proportion of diets were developed and evaluated with WDNR fisheries biologists who have worked with the species of interest for several years.

Growth Rate

Commenters stated that the growth rate used in FRFood was not appropriate for application to the Lower Fox River, and that the appropriate growth rate should be at least an order of magnitude lower than that applied. One argument was that the growth rate used would result in PCB concentrations too high from observed values.

The growth rate constant used in FRFood was 0.002, which was obtained from the original Gobas model. This value is appropriate given the value was developed for Lake Ontario for similar species and conditions found in the Lower Fox River. Growth rate, within the Gobas framework, used a constant to account for dilution of PCB concentration due to growth. Intuitively, arguing for a lower growth rate (0.0002 as the commenter suggests) would result in less dilution. As a sensitivity check, FRFood was run using parameters for OU 1, with growth rates set at one order of magnitude above and below the growth rate used for the FS. As can be seen in the table below, using a growth rate one order of magnitude below results in an increase in PCB wet weight (ww) concentrations in fish. Increasing the growth rate results in a lower concentration of PCBs.

Growth Rate	0.0002	**0.002**	0.02
Sediment (mg/kg)	3.8	**3.8**	3.8
Carp – Adult (mg/kg ww)	4,560	**2,639**	506
Carp – YOY	2,859	**1,607**	299
Dissolved in Water	0	**0**	0
Emerald Shiner (mg/kg ww)	1,610	**868**	155
Gizzard Shad (mg/kg ww)	1,220	**358**	44
Oligochaetes	268	**268**	268
Phytoplankton	27	**27**	27
Total in Water	0	**0**	0
Walleye – Adult (mg/kg ww)	6,146	**2,109**	207
Walleye – YOY	6,132	**2,091**	157
Yellow Perch – Adult (mg/kg ww)	2,169	**1,443**	332

References

Connolly, J. P., T. F. Parkerton, J. D. Quadrini, S. T. Taylor and A. J. Thuman, 1992. *Development and Application of a Model of PCBs in the Green Bay, Lake Michigan Walleye and Brown Trout and Their Food Webs*. Report to the United States Environmental Protection Agency, Grosse Ile, Michigan. Cooperative Agreement CR-815396.

EPA, 1993. Updated version of the Region 8 CWA Section 304(a) criteria chart. United States Environmental Protection Agency.

EPA, 1994. *Estimating Exposure to Dioxin-Like Compounds, Volume II: Properties, Sources, Occurrence and Background Exposures*. Review Draft (do not cite or quote). EPA/600/6-88-005Cb. United States Environmental Protection Agency, Washington, D.C.

EPA, 2000. *Responsiveness Summary – Hudson River PCBs Site Record of Decision*. Prepared for United States Environmental Protection Agency, Region 2 and United States Army Corps of Engineers, Kansas City District by TAMS Consultants, Inc. January.

EVS, 1998. *Sheboyan River and Harbor Aquatic Ecological Risk Assessment (Volume 1 of 3), Seattle, Washington*. Prepared by EVS Environment Consultants and National Oceanic and Atmospheric Administration.

Exponent, 1999. *Technical Memorandum 7a: Analysis of Bioaccumulation in the Fox River*. Prepared for the Fox River Group and the Wisconsin Department of Natural Resources by Exponent, Bellevue, Washington. February.

GAS/SAIC, 1996. *Remedial Investigation Report for Contaminated Sediment Deposits on the Fox River (Little Lake butte des Morts to the De Pere Dam)*. Graef, Anhalt, Schloemer & Associates (GRAEF) and Science Applications International Corporation (SAIC). September 24.

Gobas, F. A. P. C., 1993. A model for predicting the bioaccumulation of hydrophobic organic chemicals in aquatic food webs: Application to Lake Ontario. *Ecological Monitoring*. 69:1–17. December 8.

Magnuson, J. J. and D. L. Smith, 1987. *Food Chain Modeling Needs Obtained Through Stomach Analysis of Walleye and Brown Trout*. Final Report to United States Environmental Protection Agency. University of Wisconsin.

WDNR, 2001. *Technical Memorandum 7c: Recommended Approach for a Food Web/Bioaccumulation Assessment of the Lower Fox River/Green Bay Ecosystem*. Wisconsin Department of Natural Resources. January.

Master Comment 6.16

Commenters stated that FRFood contained errors and other limitations that caused FRFood to generate predictions which conflict with known data from the River.

Response

The WDNR and EPA disagree with this statement. As noted in the previous comment, both point and wLFRM/GBTOXe-coupled predictions matched very well with measured fish tissue concentrations in the Lower Fox River and Green Bay Zone 2, and readily met the model evaluation metrics developed in the GBMBS and agreed upon by the WDNR in cooperation with the FRG (Limno-Tech, 1998). As described in Technical Memorandum 1 of the *Model Documentation Report*, the metric applied to bioaccumulation models is plus or minus one-half order of magnitude**.** Given that results of FRFood from either point or coupled calibration with the transport models was within 0.6 to 2.2 times observed values, the model fits well within the FRG agreed-to model metric.

Both during the calibration period, and when using a straight-line projection from the calibration period to the most recent data collected in 1998, the coupled transport/FRFood model provided a good projection that matches well with the observed fish tissue concentrations. Figures 3-3, 3-5 (see Figures 5 and 6 above), 3-6, and 3-7 (Figures 7 and 8 below) from the *FRFood Model Documentation Memorandum* show that for OUs 1 and 4, and Green Bay Zone 2, FRFood model projections accurately represent observed fish tissue concentrations; both within the calibration period and projected into 1998.

Figure 7 FRFood Calibration: Green Bay Zone 2, Forage Fish

Fox River Food (FRFood) Model Documentation Memorandum

Figure 3-6 FRFood Calibration: Green Bay Zone 2
Predicted vs. Observed Concentrations in Forage Fish
1989–1990

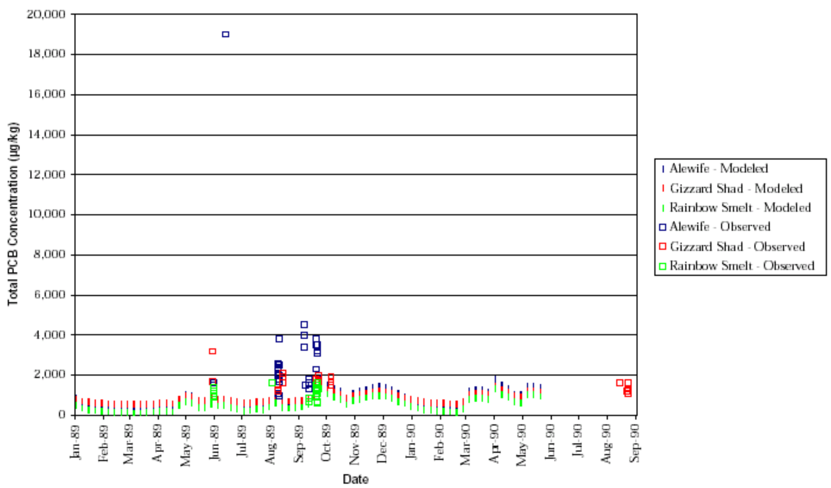

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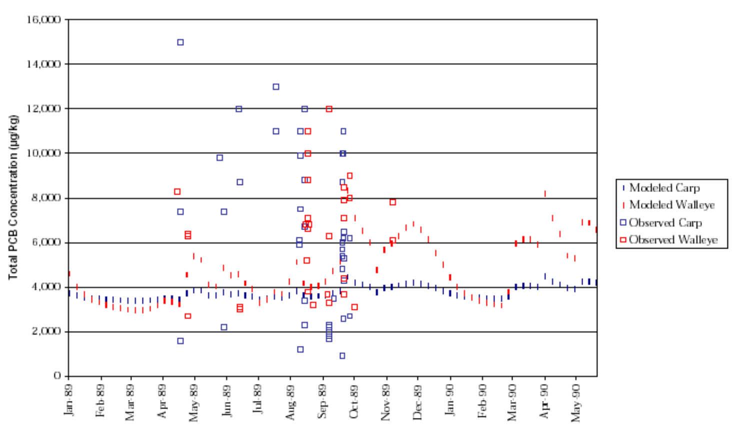
Figure 8 FRFood Calibration: Green Bay Zone 2, Walleye and Carp

Fox River Food (FRFood) Model Documentation Memorandum

Figure 3-7 FRFood Calibration: Green Bay Zone 2
Predicted vs. Observed Concentrations in Walleye and Carp
1989–1990



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In addition, the commenter errs in citing The Mountain-Whisper-Light time trends analysis as "evidence" that trends in fish tissue concentrations are decreasing in the River. What specifically the Time Trends Analysis did report was that that the rate of decline in fish tissue concentrations observed through the 1970s changed from a decline, to either a steady state, or an increase in concentrations in fish tissue PCB concentrations. Several important fish species, including carp, perch, and walleye, show statistically significant slowing of the decline rate, with a breakpoint occurring in the trend in the early to mid-1980s. Carp in OU 4, for example, showed a significant increase in concentrations. This process and the errors in the commenters' analyses of the Time Trends Analysis are discussed in Master Comment 2.11 (98, 99, 207, 208, 209), and in *White Paper 1 No. – Time Trends Analysis*.

Reference

Limno-Tech, 1998. *Review of RETEC Fox River Feasibility Study Draft Chapter 5, Section 5.1 "Contaminated Sediment Ranking."* Prepared for the Fox River Group by Limno-Tech, Inc. January 11.

Master Comment 6.17

Commenters stated that since FRFood is a steady-state model, which limits its capability to reflect the delayed response of fish tissue PCB concentrations in response to changes in sediment and water column PCB concentrations. They further argue that a steady-state model such as FRFood cannot capture system responses that can be expected from active remediation.

Response

The commenters are correct in that the original algorithms developed by Gobas reflect steady-state conditions; i.e., for a single point in time, the concentration reflected in the water column or sediment is reflected as an estimated concentration in the fish for that point in time. The model does not reflect how that concentration might change if no further exposure continued or if there were momentary spikes in chemical concentrations. If applied in and of itself, there are limitations to the applicability of this type of model for short-term predictions.

The purpose of applying the models was to account for long-term changes in PCB concentration in sediment, the water column, and ultimately fish tissue concentrations. When coupled with either wLFRM or GBTOXe, which provide output in much shorter timeframes (as frequently as one output per day), FRFood has the ability to project the expected concentration in fish. This ability to reflect shorter-term responses of PCB concentrations in fish can be seen on Figures 5, 6, 7, and 8, above, which represent the monthly fluctuation in PCB concentrations during the calibration period. As PCB concentrations spike during the spring and summer months, fish tissue concentrations also spike. As concentrations drop down to lower levels, fish concentrations of PCBs do as well. While it can be effectively argued that the model does not incorporate the lag that could be expected in response to a change in fish tissue concentrations, the Agencies do not view that as a liability of the model.

Master Comment 6.18

Commenters stated that FRFood does not account for the effect of habitat and habitat preference on fish exposure to PCBs in sediments.

Response

WDNR and EPA disagree with this statement. FRFood applied a scale appropriate for remedial decision-making on the Lower Fox River, as well as adequately considered “habitat preference” in model use.

A number of different aerial scales could have been applied throughout the RI/FS to evaluate and manage risk. The Agencies elected to evaluate risk on a reach-wide scale, although smaller units (e.g., deposits, SMUs) could have been independently evaluated. The Agencies believe that the appropriate scale for making remedial decisions and managing risk is at the OU level. Furthermore, the Agencies believe that restricted feeding areas, described as “microhabitats,” are not appropriate for the Lower Fox River or Green Bay. Walleye, perch, carp, and other forage species examined in the RI/FS have wide home ranges, and it is not appropriate to restrict analyses to smaller units.

In addition, the Agencies believe that the commenters err in describing the routes of exposure for fish within the Lower Fox River and Green Bay. The food web and routes of potential exposure are described in both TM7b (Exponent) and TM7c (WDNR, 2001). Both the FRG consultants and WDNR fisheries biologists agree in both documents that the Lower Fox River food web is best described as a pelagic system, with a small component of the food chain being based upon benthic organisms. The major carbon-generating cycles occur within the water column, and not in the sediments. More specifically, PCB exposure and bioaccumulation occurs because of resuspension of sediments and uptake in the food chain via the water column. This may not be true for all species; carp, for example, are bottom feeders and these have been modeled accordingly. The persistence with which the commenters point to the sediment as an exposure route is not consistent with an analysis of habitat; the habitat “preference” for species within the Lower Fox River and Green Bay is in the water column, not sediment.

References

Exponent, 1999. *Technical Memorandum 7a: Analysis of Bioaccumulation in the Fox River*. Prepared for the Fox River Group and the Wisconsin Department of Natural Resources by Exponent, Bellevue, Washington. February.

WDNR, 2001. *Technical Memorandum 7c: Recommended Approach for a Food Web/Bioaccumulation Assessment of the Lower Fox River/Green Bay Ecosystem*. Wisconsin Department of Natural Resources. January.

Master Comment 6.19

Commenters stated that neither FRFood nor GBFood should be used to derive SQTs.

Response

WDNR and EPA disagree with this comment. As noted in Master Comment 6.15, the underlying Gobas algorithms applied in FRFood have been successfully applied at several Superfund sites and in the development of the GLWQI criteria. The Agencies believe that the Gobas algorithms are demonstrably applicable in evaluating bioaccumulation. GBFood was not used in setting SQTs.

The Agencies also believe that FRFood is appropriately applied to setting SQTs. EPA Region 5 provided a guidance document on the use of bioaccumulation models for setting sediment cleanup goals in the Great Lakes (Pelka, 1998). However, and important distinction of SQTs is that they are not sediment cleanup goals. SQTs should be considered as receptor-specific point estimates; i.e., they are calculated for a specific sediment location, pathway, and receptor. The SQTs themselves are not cleanup criteria, but are a good approximation of protective sediment thresholds and were considered to be "working values" from which cleanup goals were selected. SQTs do not vary by OU, but may vary by Superfund site, given the type of contamination, the types of species, site-specific exposure potential, the location-specific information available at a specific Superfund site, etc. WDNR and EPA believe that the SQTs developed for the Lower Fox River and Green Bay site are specific site-wide.

See also Master Comment 4.8 (44, 67) and *White Paper No. 11 – Comparison of SQTs, RALs, RAOs, and SWACs for the Lower Fox River*.

Reference

Pelka, A., 1998. Bioaccumulation models and applications: Setting sediment cleanup goals in the Great Lakes. *Proceedings of the National Sediment Bioaccumulation Conference*. 5-9–5-30.

6.4 FoxSim (the Fox River Group Model)

Master Comment 6.20

A group of commenters submitted an alternative model, known as FoxSim, and made various claims based on the forecasts generated by FoxSim and, in some cases, compared those forecasts to the modeling work identified in the *Model Documentation Report*.

Response

In response to the submittal of this model and the various claims, WDNR's Water Quality Modeling Section reviewed FoxSim. The finding of that review was that the FoxSim model contains high uncertainties in its ability to predict PCB fate and transport in the Lower Fox River system. The model was constructed with a stated bias to "evaluate the on-going and future natural attenuation of the system." This is accomplished through the model's prediction of deposition of clean sediments and less scour of contaminated sediments, which leads to a prediction of less availability of PCBs to the water column and transport of PCBs within the River, and from the River to Green Bay. Please see *White Paper No. 15 – WDNR Evaluation of FoxSim Model Documentation* for more information.

Master Comment 6.21

One Commenter stated that when using different models, the remedy from the Proposed Plan does little to reduce projected human health risks and that changes to numerical risk estimates are minor and are not significant, given the uncertainty of the analysis.

Response

WDNR and EPA disagree with the foundation of this statement; that the models used in the RI/FS are flawed. Over the years, WDNR has worked cooperatively and collaboratively to develop the models that can be used as a tool to assist in decision making on this project. The Agencies' primary model is wLFRM. This model was initially developed as part of the Green Bay Mass Balance Study (GBMBS) as part of a suite of coupled water quality models describing PCB transport in the Lower Fox River and Green Bay were developed. Since the end of the GBMBS, efforts to examine and assess the performance of Lower Fox River water quality models have continued. Four generations of water quality model development have been initiated. The model developed as part of RI/FS efforts is the result of continued assessments of Lower Fox River water quality model performance and represents the fourth generation of model development. To distinguish this model from prior generations of development, this fourth generation model is identified as the "whole" Lower Fox River model (wLFRM).

Development of the wLFRM was based on the results of a 1997 agreement and a peer review of model performance with the Fox River Group (FRG). A component of the agreement was to evaluate water quality models for the Lower Fox River and Green Bay with the intent of establishing goals to evaluate the quality of model results and a Model Evaluation Workgroup was formed (the Workgroup), and was comprised of technical representatives for the FRG and WDNR in order to undertake "cooperative and collaborative" evaluations of model performance. Development of a series of technical reports followed. The series of reports developed by the Workgroup were each prepared as a Technical Memorandum (TM) and are included in the Model Documentation Report. The TMs provide detailed analyses of key aspects of model development such as solids and PCB loads, sediment transport dynamics, and initial conditions.

In addition to the Workgroup efforts, a peer review panel presented additional assessments of model performance. To the greatest extent practical, peer review panel recommendations were integrated into wLFRM development efforts. The wLFRM describes PCB transport in all 39 miles of the Lower Fox River from Lake Winnebago to the River mouth at Green Bay in a single spatial domain.

More information on wLFRM development can be found in the Model Documentation Report which was prepared as a supporting document to the RI/FS and in *White Paper No. 16 – wLFRM Development and Calibration for the Lower Fox River/Green Bay Remedial Investigation, Feasibility Study and Proposed Remedial Action Plan.*

The models used to support these claims do not appear to have been subject to same degree of scientific scrutiny and peer review as was wLFRM. WDNR did review the FoxSim model. The conclusions of that review can be found in *White Paper No. 15 – WDNR Evaluation of FoxSim Model Documentation***.**

7 Potential In-River Risks from Remedial Activities

7.1 Habitat Impacts from Dredging and Capping

Master Comment 7.1

Several commenters expressed concerns that the Proposed Plan remedy would resuspend PCB concentrations in the water column, thereby increasing invertebrate and fish tissue PCB concentrations with a subsequent increase in ecological risks.

Response

WDNR and EPA disagree with this assessment. Potential deleterious impacts on biota due to dredging and capping were analyzed in *White Paper No. 8 – Habitat and Ecological Considerations as a Remedy Component for the Lower Fox River*. Impacts analyzed included the effects from TSS, resuspension of toxic materials, physical removal of benthic populations, and change in substratum from cap placement.

The effects of TSS on aquatic biota have been studied for a wide variety of aquatic organisms. The general conclusion of those studies is that significant adverse impacts are not associated with typical dredging projects of uncontaminated materials, although some localized effects can occur at higher resuspended concentrations (Guannel et al., 2002). Those authors concluded that resuspended sediment concentrations caused by natural phenomena (floods, storms, winds, etc.) are often higher and of longer duration than those caused by dredging. This is well documented in the monitoring records of the pilot projects, Deposit N and SMU 56/57, as well as dredging projects where pre-dredging TSS measurements were more than double the levels observed during dredging (FRRAT, 2000).

Resuspension of contaminated sediments on aquatic biota has been more difficult to assess. PCBs at the levels reported in the two demonstration projects on the Lower Fox River are not likely to have an immediate, acute effect on the aquatic organisms. The BLRA for the Lower Fox River documents the levels of PCBs that are acute or chronically toxic to aquatic biota. The water quality monitoring conducted during the pilot dredging projects demonstrated that even during remediation at the most highly contaminated site in the River, PCB concentration did not approach these levels. Nor were those concentrations very different from PCB concentrations that have been observed in the water column absent dredging activity. Further, both dredging and capping have the potential to resuspend sediments, but the levels of resuspended solids and PCBs are lower than those naturally occurring in the Lower Fox River. Consequently, the effects from resuspension would be negligible

See also the response to Master Comments 7.16 and 5.4 and *White Paper No. 8 – Habitat and Ecological Considerations as a Remedy Component for the Lower Fox River*.

References

FRRAT, 2000. *Evaluation of the Effectiveness of Remediation Dredging: The Fox River Deposit N Demonstration Project November 1998–January 1999*. University of Wisconsin Water Resources Institute Special Report WRI SR 00-01.

Guannel, G., T. Wang, S. Cappellino, and C. Boudreau, 2002. Resuspended sediment effects in aquatic environments from dredging operations. *Proceedings of the Western Environmental Dredging Association Twenty-Second Technical Conference, June 12–15, 2002, Denver, Colorado*. p. 165–178.

Master Comment 7.2

The commenters state that capping would have fewer negative impacts than dredging.

Response

WDNR and EPA disagree with the comment that capping will have fewer negative impacts than dredging. Impacts from both capping and dredging are presented in *White Paper No. 8 – Habitat and Ecological Considerations as a Remedy Component for the Lower Fox River*. This white paper presents numerous case studies, which examined dredging effects on biota. While densities of benthic organisms were severely reduced in the short-term by dredging, recolonization was rapid (e.g., Wisconsin Spring Ponds and River Hull, England [Pearson, 1984]). *White Paper No. 8 – Habitat and Ecological Considerations as a Remedy Component for the Lower Fox River* also presented case studies examining effects on biota from capping. Currently, there are no good examples of capping projects that exist in any similar riverine system anywhere in the world. Consequently, this white paper examined other environs for comparisons. One case study, the Simpson capping project in Tacoma, Washington (Stivers and Sullivan, 1994), showed epibenthic populations and variability since cap construction has been similar to the ranges and variability found at various reference sites tested during the 5 years of monitoring. Another case study, Soda Lake, Wyoming (ThermoRetec, 2001c), found that 11 months following capping chironomids were approximately twice as abundant and oligochaetes were greater than six times as abundant at cap stations than off-cap stations. Shannon diversity was lower at both cap and off-cap stations than the baseline investigation, averaging 0.32 and 0.17, respectively. Prior to cap placement, oligochaetes were present at only five of the ten stations sampled, but dominated following cap placement. The substrate change from silt and clay to sand and the absence of organic content are likely the cause a decline in diversity.

References

Pearson, R. G., 1984. Temporal changes in the composition and abundance of the macro-invertebrate communities of the River Hull. *Archiv fur Hydrobiologie*. 100:273–298.

Stivers, C. E. and R. Sullivan, 1994. Restoration and capping of contaminated sediments. In: *Dredging '94: Proceedings of the Second International Conference on Dredging and Dredged Material Placement, 14–16 November 1994, Orlando, Florida*. E. C. McNair, Jr. (ed). American Society of Civil Engineers, New York, New York. p. 1017–1026.

Master Comment 7.3

Numerous commenters had concerns that the remedial activities would cause damage to or loss of habitat for ecological receptors including negative food web impacts.

Response

Potential deleterious impacts upon habitat were a consideration for the proposed remedies for the Lower Fox River. An analysis of the habitat impacts contained in *White Paper No. 8 – Habitat and Ecological Considerations as a Remedy Component for the Lower Fox River*, concluded that the remedial activities would have minimal impact on aquatic communities. Contrary to the comments concerning habitat, the analyses contained in that white paper found the following:

1) Dredging will not take place in sensitive wetland areas;

2) Current submerged aquatic vegetation (SAV) within the remedial areas is composed principally of Eurasian milfoil (*Myriophyllum spicatum*), an exotic invasive species, and a common floating pondweed (*Potamogeton* spp.);

3) Benthic invertebrate populations should recover quickly in depositional areas of the Lower Fox River following dredging activities; and

4) The Lower Fox River food web is pelagial not benthic, and therefore would be less impacted by removal activities.

Each of these items is discussed in more detail below with further relevant discussion in *White Paper No. 8 – Habitat and Ecological Considerations as a Remedy Component for the Lower Fox River*.

Marsh habitat is an important and sparse asset on the Lower Fox River, and any remedial alternative will weigh the environmental risks from PCBs left in place against the risks of loss of habitat. The remedy defined in the Proposed Plan does not impact the remaining marshes in the Lower Fox River. If during the final design, areas are found to exist that may impact marsh habitat, then the relative risk of leaving PCBs in place and allowing natural attenuation to occur will be weighed against the risk of loss of habitat. In Little Lake Butte des Morts, the marshland around Stroebe Island has been identified by the WDNR as a valuable spawning habitat for bluegill, sunfish, and bass, and the last remnant of northern pike spawning ground; it should not be a part of any ultimate removal or capping action.

There are very few areas where rooted SAV still exist within the Lower Fox River system. The SAV in the removal areas is composed primarily of Eurasian milfoil (*Myriophyllum spicatum*), a noxious invasive exotic species, and decomposing stands of common pondweed (*Potamogeton* spp.). Both species will quickly re-inhabit dredged areas. Capping will impact SAV to the same extent as dredging. An additional benefit of dredging will be the removal of nitrogen, phosphorus, and potassium, which contributes to eutrophication.

Recovery of benthic invertebrate populations from dredging and capping activities is discussed in response to Master Comment 7.1. Based upon case studies, the general expectation is immediate loss of benthic invertebrate populations followed by quick repopulation. Considerations for benthic repopulation were a component in the design of the remedial activities. For example, the extended dredging schedule will allow for organisms within the 1 ppm footprint yet to be dredged to serve as source populations for adjacent areas, which have already been dredged. The types and proximities of undisturbed areas near the dredged areas will likely provide substantial sources for recolonization. The areas not proposed for dredging have more coarse substrates that generally host more diverse benthic invertebrate populations. It is highly probable that these organisms will migrate to dredged areas as part of drift. As discussed below in the response to Master Comment 7.5, the Lower Fox River food web is pelagial not benthic, and therefore, impacts to benthos are expected to have negligible impacts to the remaining food web.

Fish will not be affected by any of the proposed remedial alternatives. Fish are generally able to avoid dredging activities and relocate to habitat suitable for their feeding and reproductive needs. The fish present in the Lower Fox

River are mobile species that seek out appropriate spawning habitat. Many naturally occurring backwater areas are present in Little Lake Butte des Morts as well as other artificial backwater areas resulting from dams in the Lower Fox River. These areas, along with tributaries entering along the entire River, are valuable backwater habitats that provide sources to which migration may occur and shelter during disturbances like dredging. Critical habitat for desired game species such as walleye or bass on the Lower Fox River are outside of the areas proposed for removal actions. Also, sufficient cover and spawning habitats provided by SAV are available before, during, and after dredging.

Either removal or isolation (dredging or capping) will have minimal overall impact to the food web. The food web of the Lower Fox River is referred to as a pelagic food web due to the heavy dependence on water column organisms and therefore will likely be unaffected by removal or isolation of benthic organisms. The fish in the Lower Fox River are primarily dependent on water column organisms, and although benthic organisms may be temporarily unavailable, the majority of the food organisms will be present in areas near dredging activities. See also the response to Master Comment 7.1 and *White Paper No. 8 – Habitat and Ecological Considerations as a Remedy Component for the Lower Fox River*.

Master Comment 7.4

Commenters opined that the FS and Proposed Plan failed to adequately assess the adverse environmental impacts of the proposed project, including the loss of SAV, substrate materials (gravel, snags), food sources essential for fish breeding and feeding, and food web impacts. Further, no attempts had been made to overlay areas to be dredged with an inventory of valuable habitat.

Response

Many aspects of the concerns expressed by these commenters are addressed in the response to Master Comment 7.3. The concern over loss of substrate material was addressed in the Proposed Plan. Areas targeted for dredging or capping in the Lower Fox River are predominantly soft, aqueous, and silty sediments. As discussed in *White Paper No. 8 – Habitat and Ecological Considerations as a Remedy Component for the Lower Fox River*, fish in the Lower Fox River utilize open substrate like cobble with high dissolved oxygen for spawning and adult habitat. These areas are not targeted for dredging. Further, the NRDA restoration will target habitat enhancements, which is consistently called for by WDNR. Habitat enhancements contained in the remedy support the diversification of the fish assemblages within the River and the creation of more nearshore, shallow littoral habitat.

Finally, an overlay of areas to be dredged with an inventory of valuable habitat had been conducted in *White Paper No. 8 – Habitat and Ecological Considerations as a Remedy Component for the Lower Fox River*.

Master Comment 7.5

Commenters complained that there has been no assessment of impact on the food web in general and specific fish populations in particular.

Response

Effects on the food web from any active form of remediation has indeed been considered. For most of the Lower Fox River, a temporary disruption, displacement, and recolonization of benthic and fish populations will occur as incremental sections of the River are dredged and/or capped. Since the remedial programs will proceed incrementally, covering food sources, covering aquatic vegetation, and displacement of fish populations will occur. While commenters continue to try to place significance on the benthic component of the Lower Fox River food web, this is not a significant component. The Lower Fox River as a pelagic-based food chain has been documented and agreed to by both WDNR and the FRG (WDNR, 2001; Exponent, 1999). In short, neither dredging nor capping would produce any short-term real impacts to aquatic biota of the Lower Fox River. Dredging would not interrupt the pelagic component of the food web. Please see response to Master Comment 7.3 for a discussion of food web impacts. See also *White Paper No. 8 – Habitat and Ecological Considerations as a Remedy Component for the Lower Fox River*.

References

Exponent, 1999. *Technical Memorandum 7a: Analysis of Bioaccumulation in the Fox River*. Prepared for the Fox River Group and the Wisconsin Department of Natural Resources. Exponent, Bellevue, Washington. February.

WDNR, 2001. *Technical Memorandum 7c: Recommended Approach for a Food Web/Bioaccumulation Assessment of the Lower Fox River/Green Bay Ecosystem*. Wisconsin Department of Natural Resources, Madison, Wisconsin.

Master Comment 7.6

The API Panel's conceptual model is also premised on its conclusion that the River as a fishery and wildlife habitat has been degraded by a variety of human activities and not just sediment contamination. Full recovery of the habitat values requires habitat restoration as well as management of the contaminants within the sediments. The conceptual model is based on the conclusion that fish/wildlife habitats degraded by human activities, not just contaminated sediments need habitat restoration/creation as well as sediments management.

Response

WDNR and EPA concur with the goal of the statement above. It is consistent with the conceptual model on which CERCLA is based: remove the risk to health and the environment, and compensate for the environmental injuries caused by the release of the contaminants. The design and implementation of the selected remedial alternative must be conducted in a way that is sensitive to the ecological value of the action. The ROD will be prepared in consideration of these concepts, in addition to the reliability and permanence of the remedy.

Master Comment 7.7

Commenters argued that Habitat Suitability Index (HIS) and In-stream Flow Incremental Methodology (IFIM) models should be used to determine habitat requirements for Lower Fox River fish. Habitat variables will be influenced by capping.

Response

A wide variety of bottom substrates already exist in the Lower Fox River. Areas of cobble, gravel, sand, and soft substrate types are found throughout the River. A wide range of species is currently effectively using available habits. Spawning habitat may be limited to some extent for walleye and smallmouth bass in the Lower Fox River, but both are reproducing in the Lower Fox River, with walleye being fairly successful. However, the proposed capping material of sand and fine gravel has not been demonstrated to be the favored material for spawning. Walleye in the Lower Fox River and Green Bay prefer to spawn over large gravel and cobble with the greatest success occurring over 2- to 6-inch material. Smallmouth bass will spawn where finer materials are present but the finer substrates should be associated with larger gravel and cobble. Beyond the appropriateness of the size of the material, it is difficult to imagine that given unlimited resources and the mission to improve the habitat on the Lower Fox River, the choice would be made to cover extensive areas of the bottom substrate with a single, homogenous type of material. The Green Bay Remedial Action Plan (RAP) has long advocated for improved habitat, but the habitats that are deficient are extensive areas of rooted aquatics. Poor light penetration is the cause of the absence of this habitat, not improper substrate. Submergent macrophytes would help to provide habitat favoring the centrarchid family (primarily bluegill, largemouth bass, and pumpkinseed), which are poorly represented in the fish community.

Master Comment 7.8

Commenters stated that filling the River with sand and gravel is not "habitat enhancement."

Response

WDNR and EPA concur with this comment and this consideration was taken into account in the remedial design. Capping likely will have similar effects to dredging on aquatic vegetation and benthic invertebrate and fish communities; however, recovery of benthic invertebrate communities following capping likely will be slower than recovery following dredging due to decreased organic content of the sediment. Because of the lack of organic material in a potential sand or gravel cap, rooted SAV will likely not reestablish in areas where it was present prior to dredging until sufficient organic material accumulates on the cap. Seeds contained in the drift may settle in the sand or gravel cap; however, they are less likely to settle and root in the non-organic substrate. Further, the cap and gravel substrate will not be good walleye habitat if it is located in areas of low flow.

As discussed, in the response to Master Comment 7.4 above, habitat restoration is covered and will occur under the NRDA. See also, *White Paper No. 8 – Habitat and Ecological Considerations as a Remedy Component for the Lower Fox River*.

Master Comment 7.9

Commenters noted that the cap as proposed would require an enormous volume of sand and gravel that would need to be excavated locally in order to be cost-effective. This habitat destruction would offset any River habitat enhancement. The mined cap material would need to be transported and placed in the River with heavy equipment.

Response

While WDNR and EPA agree there would be upland impacts from material mining, evaluation of upland habits from mining was outside the scope of the RI/FS.

Master Comment 7.10

Commenters stated that, the Proposed Plan should include actions to minimize sedimentation that could lead to recontamination of the Site.

Response

WDNR and EPA believe that implementation of a remedy at the 1 ppm action level will lead directly to a reduced loading of PCB-contaminated sediments.

While low levels of PCBs will remain in the system, the selected remedies do allow for the natural attenuation of the residuals over time.

7.2 Water Quality

Master Comment 7.11

The commenters suggested that the proposed remedy claims to have selected an alternative "using environmental dredging techniques that minimize adverse environmental impacts, including resuspension of sediment during dredging," but offers no quantitative assessment of the potential negative consequences of PCB releases.

Response

The Agencies believe that appropriate loading criteria from losses due to dredging should be equal to those determined during the dredging project at SMU 56/57. Based on these results, where the commenter acknowledged that this set of data represents the most comprehensive data set available, the PCB loss approximated 2.2 percent of the mass removed. Applying the loss rates from this project that removed the most highly contaminated sediment in the entire Lower Fox River to the proposed remediation would equate to a total loss of 644 kg of PCBs. If one were to accept the commenter's other opinion that the annual PCB export from July 2000 to July 2001 was up to 106 kg of PCBs and that the rate of decline approximates a half-life of 9 years at face value, over the next 20 years a significantly greater amount of PCBs will be resuspended from the River sediments and transported to Green Bay than active remediation. Similarly, the target removal of 1,700 kg of PCBs from Little Lake Butte des Morts would potentially release less than 40 kg of PCBs, an amount roughly only double the amount one commenter suggested is contributed by sediments annually to the loading leaving Little Lake Butte des Morts.

Relative to PCB concentrations, data collected during high-flow events or ship movements within the River have clearly shown that these actions frequently result in concentrations equal to concentrations found during dredging. Please also see the response to Master Comment 7.22.

Master Comment 7.12

A commenter suggested the use of estimated releases of PCBs to the water column from other sites to infer losses that should be expected in the Lower Fox River.

Response

WDNR and EPA believe that the resuspension losses of 2.2 percent documented at SMU 56/57 on the Lower Fox River are the most representative, relevant, and site-specific estimates available. WDNR and EPA agree that "Variations in site characteristics, the components of the remedy and their relevance to the lower Fox River, the method of sediment removal, the method and effectiveness of environmental controls, volume of sediment removed, and multiple contaminants of concern make direct comparisons between "successes" at other sites to the proposed project for the lower Fox River nearly impossible." Please also see the response to Master Comment 7.22.

Master Comment 7.13

Commenters stated that dredging results in remobilization of PCBs to the water column.

Response

Resuspension of PCBs and sediments due to dredging is a well-documented condition. However, it is concluded from the Lower Fox River demonstration projects that water column PCB levels, as a result of downstream transport of dredging-induced resuspension, will be a minor fraction of currently existing levels. Any increased loading will be minor relative to current conditions. Therefore, dredging-induced releases, which are short-term in nature, will not result in significant impacts to the River nor significantly affect the ensuing decline of PCB concentrations in sediments and water resulting from sediment removal. As documented during the dredging at SMU 56/57, normal River activities (e.g., vessel movement) have the potential to resuspend similar quantities of PCBs as does removal.

Water column parameters will be monitored during dredge operations in order to ensure that a minimal amount of PCBs will be transported downstream. PCB levels naturally fluctuate within the water column due to seasonal variables. In order to determine a threshold level for PCB concentration increases as a result of dredge operations for inclusion in the final remedial design, WDNR and EPA will likely resume dredging at SMU 56/57 in 2000, much as they did in the Consent Decree with Fort James. If the water samples during dredge operations indicate that the downstream PCBs transport is within the natural variation, then there will be no impact of dredging downstream. On the other hand, if surface water sampling finds levels of PCBs above the variation observed in "naturally" occurring concentrations, then further preventative measures will be employed in order to minimize the downstream impact.

Master Comment 7.14

Commenters suggested that the proposed remedy would increase water column and fish tissue concentrations over the short term and will wreak considerable damage upon the ecosystem of Little Lake Butte des Morts.

Response

The commenters did not provide any quantitative assessment that losses from dredging will be greater than losses from natural attenuation or capping. Therefore, a direct response cannot be provided as a result of the commenters' failure to provide details sufficient to back up their claim. However, one of the commenter's own analyses suggests that the total mass of PCBs lost under the natural attenuation option would exceed that from removal. Based on the results of dredging at SMU 56/57, where the commenter acknowledged that this set of data represents the most comprehensive data set available, the PCB loss approximated 2.2 percent of the mass removed.

Even applying the loss rates from the most highly contaminated site on the River to the entire Lower Fox River, proposed remediation would equate to a loss of 644 kg of PCBs. On the other hand, the commenter's offer that the annual PCB export from July 2000 to July 2001 was up to 106 kg and that the rate of decline approximates a half-life of 9 years. If one were to accept these numbers at face value, over the next 20 years almost 30 percent more PCBs would be resuspended from the River sediments and transported to Green Bay. Similarly, the commenter does not provide a basis for their claim that losses from a capping activity would be less than dredging. Lack of a quantitative comparison creates the illusion that the capping process would not cause loss of PCBs when in fact advective and diffusive losses in addition to direct resuspension of contaminated sediment will occur during placement of the cap and consolidation of the sediment below the cap.

Master Comment 7.15

The Proposed Plan noted measurements of TSS during passage of a coal boat during the demonstration project at SMU 56/57 and related that to risk of sediment scour. Commenters noted that neither the FS or Proposed Plan provide a basis for the statement "the role and scale that commercial shipping traffic can play in resuspending and redistributing PCB-contaminated sediment within the navigation channel."

Response

The monitoring funded by the FRG during the 1999 pilot dredging project at SMU 56/57 documented the increased turbidity and directly measured elevated PCB concentrations as a direct result of only the movement of the coal boat. The authors concluded that: "Vessel movement is a continuing PCB transport mechanism regardless of dredging operations." As the sediment is the only possible source of the elevated suspended solids and PCBs, this data documents that commercial ship traffic has the potential to locally scour sediments.

Master Comment 7.16

A commenter observed that in Section 5.1, which attempts to discuss issues of risk reduction versus source removal, WDNR states without reference or support that "(m)any of the projects had elevated concentrations in the water column, surface sediments and caged fish tissues during dredging, although these releases were a fraction of the losses that would occur annually, assuming no removal would take place."

Response

The 20 case study projects reviewed in Appendix B of the FS all measured surface water quality downstream of the dredging area. The measurement parameters ranged from turbidity, TSS, and/or chemical concentrations. The conclusions cited in all of these documents (when available) were that site-specific surface water quality action levels were not exceeded except in a few isolated and explainable cases (i.e., passing ships, silt curtain disturbance). The action levels developed for these projects were presumably protective of human health and the environment. Few studies, except for the Lower Fox River demonstration projects, have attempted to quantify the contaminant loss downstream during dredging as a mass and percent of mass removed. To date, WDNR and EPA are working with the best available data cited, explored, and documented in case study precedent.

It is concluded from the Lower Fox River demonstration projects that water column PCB levels as a result of downstream transport of dredging-induced resuspension will be a minor fraction of currently existing levels. The increased loads will also be small relative to current conditions. Therefore, dredging-induced releases, which are short-term in nature, will not result in significant impacts to the River nor significantly affect the ensuing decline of PCB concentrations in sediments and water resulting from sediment removal.

Water column parameters will be monitored during dredge operations in order to ensure that a minimal amount of PCBs will be transported downstream. Because PCB levels naturally fluctuate within the water column due to seasonal variables, WDNR will, during remedial design, determine a threshold level for a PCB concentration increase as a result of dredge operations. If the water samples during dredge operations indicate that the downstream PCBs transport is within the natural variation, then there will be no impact of dredging downstream. On the other hand, if surface water sampling finds levels of PCBs above the variation observed in "naturally" occurring concentrations, then further preventative measures will be employed in order to minimize the downstream impact.

This response concludes that the suspended solids increases due to dredging will be largely local (within a few hundred meters of the dredging operation) and not detectable above natural variation beyond this distance. Additionally, typical spring suspended solids levels are well above those predicted within the dredging plume.

Master Comment 7.17

Commenters noted that intermediate project results (i.e., prior to completion of project dredging) are relevant, because they reflect PCB concentrations at a time when dredging activities have ceased (e.g., during winter and spring high-flow periods when dredging is not possible) and that residual PCB concentrations during implementation indicate a potential for significantly increased risk during proposed long-term dredging.

Response

WDNR and EPA agree. Project scheduling is an important component of remedial design. WDNR and EPA will address this during remedial design following issuance of the ROD. WDNR and EPA wish to avoid the situation experienced following the first year of dredging at SMU 56/57 by the FRG where surface concentrations were significantly elevated. The remedial schedule will be done in such a way that annual dredging will be planned to be completed before weather conditions cause an increased risk of release and migration of temporarily exposed contaminants.

Master Comment 7.18

A commenter observed that USGS concluded "if one is to monitor PCB transport during a remediation operation, sole reliance on turbidity or TSS measurements is inadequate. One must also directly measure the concentration of the contaminant of interest because exposed layers of contaminated sediment and exposed concentrated pore waters can contribute to particle and dissolved-phase PCB concentrations in downstream waters."

Response

Comment noted. The Agencies plan to include particulate and dissolved PCB fractions as well as TSS monitoring into the remedial design and construction activities even though only TSS measurements were required during the 2000 dredging at SMU 56/57 completed by Georgia Pacific.

Master Comment 7.19

The commenter stated that dredging has the potential to increase exposure to mercury. The commenter pointed out that the RI reports significant concentrations of mercury in River sediment and suggests that dredging would release mercury into the water column and that dredging may also increase conversion to methylmercury.

Response

Although each environmental sediment project is unique, case study precedent is often the best indicator of potential problems that may be expected during implementation of an active remedy. Other contaminated sediment dredging projects also retained mercury as a chemical of concern requiring remediation: Wyckoff/West Eagle Harbor in Washington and Minamata Bay in Japan. Maximum mercury concentrations detected site sediments were 32 and 7,600 ppm respectively. Cleanup levels were 5 and 25 ppm respectively with targeted dredge depths ranging from 3 to 7 feet deep. In the case of Wyckoff/West Eagle Harbor (mechanical dredging with silt curtains), the residual surface sediment concentrations met the target criteria, surface water quality during dredging operations was within acceptable criteria ranges, and the project is proceeding towards long-term risk reduction as anticipated. In the case of Minamata Bay (hydraulic dredging with suction and no silt curtains), mercury concentrations were reduced by 99 percent, surface water quality during dredging was within acceptable ranges, and long-term risk reduction of fish tissue concentrations and improvement of human health was achieved. Mercury concentrations in the Lower Fox River are mostly below 5 ppm with reach averages ranging from 1.2 to 2.4 ppm (mg/kg) mercury. There is also no evidence that the remedial activity will change the physical/biological processes necessary to increase the rate of mercury methylation in the River.

For the Lower Fox River project, mercury has been included as a component of the LTMP and will likely be measured in sediment and tissue during baseline and implementation sampling events to monitor adequate environmental protection.

Master Comment 7.20

One commenter offered that PCBs from Lake Winnebago will continue to contribute to the River (despite dredging), inhibiting removal of fish advisories.

Response

All of the historical data and records have clearly pointed out that Lower Fox River sediment PCBs are the major source contributing to Green Bay. The mass of PCBs existing in sediment of the Lower Fox River and the continual release of those PCBs are of greater concern than the negligible loading from Lake Winnebago.

Master Comment 7.21

Commenters stated that much of the released PCB mass desorbs to the water column and exists in dissolved form, which silt curtains do not capture and that the FS has a flawed understanding of dredging-induced PCB releases.

Response

While problems with turbidity barriers were noted at sites such as the Grasse River, GM Central Foundry, and the Outboard Marine Site, it is important to note that the difficulties encountered at these sites were due to: (1) variable winds and current speeds in excess of those at which the barriers are effective, and/or (2) improper barrier design for site conditions.

Review of available Lower Fox River water quality data from the two demonstration projects, conducted at SMU 56/57 and Deposit N, indicate little difference between upstream and downstream TSS concentrations (USGS, 2000) when averaged over the length of the project. These projects also measured dissolved and total PCB concentrations in the water column during dredging, instead of relying solely on TSS measurements. The Lower Fox River demonstration project conducted a PCB mass balance of the entire treatment train during dredging and calculated an approximate 2 percent PCB loss downstream during dredging. It is unreasonable to expect that any active remedy (capping or dredging) conducted in the River will result in zero percent release and transport of contaminated sediments and PCBs. Some release will occur, but the projects need to define acceptable levels of TSS and PCBs. In fact, the case study review of dredging projects (Appendix B of the FS) found that individual projects developed water quality action levels during dredging (often based on mixing zone models) and that very few of these action levels were exceeded during dredging.

The use of silt curtains or other barrier devices will be determined during the project's design phase with input from the selected dredging contractor. Minimal costs for using silt curtains were included in the FS costs, but design, implementation, and deployment will ultimately be determined by the design team. Based on the monitoring results from the Deposit N demonstration project, it is possible that silt curtains will not be used at all. Please also see the response to Master Comment 7.22.

Reference

USGS, 2000. *A Mass-Balance Approach for Assessing PCB Movement during Remediation of a PCB-Contaminated Deposit on the Fox River, Wisconsin*. United States Geological Survey Water-Resources Investigations Report 00-4245. United States Geological Survey. December.

Master Comment 7.22

A commenter noted that achieving the goals of RAO 5 may require incorporation of measures to control contaminant releases during remediation. TSS monitoring or turbidity is inadequate since PCBs exist in dissolved form, which silt curtains don't capture.

Response

As noted in Master Comment 7.21, measured total suspended solids concentrations from the two demonstration projects, conducted at SMU 56/57 and Deposit N, showed very little difference between upstream and downstream TSS concentrations (USGS, 2000) when averaged over the length of the project. This information is consistent with an analysis done for the Hudson River Site (White Paper 336740), Resuspension of PCBs During Dredging, January 2002, which showed that for five projects representing 388 observations, the average resuspension loss on a volume to volume basis average 0.11 percent.

The two demonstration projects on the Fox River also measured dissolved and total PCB concentration in the water column during dredging, instead of relying solely on TSS measurements. On a mass basis (mass lost to mass removed), the loss was found to be 2.2 percent PCB loss downstream during dredging. These losses are relatively small, particularly when compared to ongoing releases from natural processes, which would continue on an indefinite and ongoing basis, assuming no action. Applying this relative loss to the total mass of PCBs consistent with the Proposed Plan (OUs 1, 3, and 4) would result in a total loss of approximately 46 pounds over an estimated 7-year dredging project (assuming removal of 64,500 pounds). This would provide an annual average release of less than 7 pounds per year. This compares to PCB loading from the Lower Fox River into Green Bay between 183 and 486 pounds per year. Without remediation, this ongoing release would continue indefinitely, whereas the 7 pounds per year would stop after completion of dredging.

The Lower Fox River remedial design would utilize similar equipment and protective measures to those evaluated in the study referenced above and would produce similar results.

Reference

USGS, 2000. *A Mass-Balance Approach for Assessing PCB Movement during Remediation of a PCB-Contaminated Deposit on the Fox River, Wisconsin*. United States Geological Survey Water-Resources Investigations Report 00-4245. United States Geological Survey. December.

Master Comment 7.23

Commenters noted that dredging will cause releases into the water column of PCBs that are currently in the sediment bed and that such release rates at the 2 demonstration projects were approximately 2.2 percent. The commenters also noted that silt curtains cannot control the movement of dissolved PCBs and the draft RI/FS assumed that no such release would occur.

Response

While problems with turbidity barriers were noted at sites such as the Grasse River, GM Central Foundry, and the Outboard Marine Site, it is important to note that the difficulties encountered at these sites were due to: (1) variable winds and current speeds in excess of those at which the barriers are effective, and/or (2) improper barrier design for site conditions.

Review of available Lower Fox River water quality data from the two demonstration projects, conducted at SMU 56/57 and Deposit N, indicate little difference between upstream and downstream TSS concentrations (USGS, 2000) when averaged over the length of the project. These projects also measured dissolved and total PCB concentrations in the water column during dredging, instead of relying solely on TSS measurements. The Lower Fox River demonstration project conducted a PCB mass balance of the entire treatment train during dredging and calculated an approximate 2 percent PCB loss downstream during dredging. It is unreasonable to expect that any active remedy (capping or dredging) conducted in the River will result in zero percent release and transport of contaminated sediments and PCBs. Some release will occur, but the projects need to define acceptable levels of TSS and PCBs. In fact, the case study review of dredging projects (Appendix B of the FS) found that individual projects developed water quality action levels during dredging (often based on mixing zone models) and that very few of these action levels were exceeded during dredging.

The use, or no use, of silt curtains or other barrier devices will be determined during the project's design phase with input from the selected dredging contractor. Minimal costs for using silt curtains were included in the FS costs, but design, implementation, and deployment will be ultimately be determined by the design team. Based on the monitoring results from the Deposit N demonstration project, it is possible that silt curtains will not be used at all.

Reference

USGS, 2000. *A Mass-Balance Approach for Assessing PCB Movement during Remediation of a PCB-Contaminated Deposit on the Fox River, Wisconsin*. USGS Water-Resources Investigations Report 00-4245. United States Geological Survey. December.

8 Implementability of Remedial Alternatives

8.1 Implementability of Dredging

Master Comment 8.1

Commenters noted the challenges that the demonstration dredging projects experienced: riverbed debris, sediment resuspension, and residual contamination of surface sediments. A commenter suggested that these problems can be avoided with: proper dredge equipment, successful construction, operation, decommission, adequate water treatment, and proper materials management/disposal.

Response

This is a principal finding of the *Sediment Technologies Memorandum* (discussed in Section 5.1.1 of this RS). This is not to trivialize the important engineering challenges that will be faced during the remedial design and implementation phase, but WDNR and EPA believe that these can be managed for the Lower Fox River.

Master Comment 8.2

Commenters maintained that the removal action proposed for the Lower Fox River would result in the destruction of habitat and impact important ecological resources on the River. The commenters suggest that a remedy impact analysis showed that dredging would result in the loss of SAV beds, which offers important habitat to invertebrates and fish. The commenters also suggest that the benthic infauna of the River will be lost with dredging, resulting in deleterious effects in the food chain.

Response

WDNR and EPA believe that the remedy impact analysis overstates the environmental issues listed in that document. As discussed in responses to comments in Section 7.2 of this RS, and in *White Paper No. 8 – Habitat and Ecological Considerations as a Remedy Component for the Lower Fox River*, important wetlands and marshlands identified in the River are outside the remedial action footprint. Furthermore, the SAV identified within the remedial footprint is principally the exotic Eurasian milfoil and floating stands of pondweed. Benthic infaunal habitat will be lost during removal, but the species of midges and segmented worms found in the Lower Fox River will quickly recolonize post-dredging. Finally, the impacts to benthos are of less concern, as the Lower Fox River food chain is principally pelagic-based.

Master Comment 8.3

A commenter disagreed with the FS's analysis of the effectiveness, implementability, and cost of large-scale dredging and disposal. The commenter stated that the FS does not adequately account for the drawbacks of dredging or the track record of dredging at other sites. The effectiveness of dredging must be evaluated in the context of risk reduction.

Response

As presented in Appendix B of the FS, the *Sediment Technologies Memorandum* provided a comprehensive evaluation of dredging projects and concluded that dredging has been successfully implemented at various sites. The "lessons learned" from these dredging projects have been considered while preparing the FS. Based on the experiences at previous dredging projects, hydraulic (cutterhead suction dredge), and mechanical dredge (clamshell bucket) have been considered in the FS. The final selection of the dredging equipment will occur during the design phase of the project. Several factors will influence the final selection that include detailed engineering planning and analysis conducted during the design phase and information obtained from potential contractors. Due to technical advancement, numerous improvements have been made to the dredging technologies. Beyond the hydraulic and mechanical dredging technologies identified in the FS, it may be necessary to review specialty equipment dredges during the design phase for potential removal operations at the Lower Fox River.

Master Comment 8.4

The implementability of dredging was brought into question by commenters who argued that the remediation of the Lower Fox River represents the largest and most complex remediation in the United States regardless of the alternative selected (capping or dredging). They further argue that on this basis, neither remedial technology has advantages in terms of previous successes in the United States.

Response

WDNR and EPA disagree with this comment. Dredging and capping experience are not comparable in terms of size and number of projects implemented. Nor is the remedial action proposed for the Lower Fox River the largest dredging program ever undertaken.

There have been over 100 years of experience with dredging projects around the world. Navigational dredging projects commonly dredge large volumes of sediment in a short timeframe. Typically, about 4 million cy of sediments are dredged by the USACE each year from Great Lakes harbors and channels. This is only a portion of the 300 to 350 million cy dredged by the USACE nationwide annually. On average, the USACE spends about $20 million annually for dredging and dredged material management in the Great Lakes basin (USACE website: http://www.lrd.usace.army.mil/gl/dredge.htm). The Port of Los Angeles hydraulically dredged and landfilled about 29 million cy of sediment for the Pier 400 construction project (1994 through 2000). Minamata Bay, Japan and Lake Ketelmeer, Netherlands, two of the largest international contaminated sediment dredging projects (that WDNR and EPA know of) dredged 1 million cy of mercury-impacted sediment in 4 years, and 1.9 million cy of impacted sediment in 1 year, respectively. Other large contaminated sediments management projects include the Slufter Depot for the Port of Rotterdam, and restoration of Lake Tunis in Tunisia. The Ketelmeer project covers a larger area and volume than the proposed action for the Lower Fox River, and is already well into the construction phase (Roukema et al., 1998).

Other sediment remedial projects that will be similar in scale in the United States include the removal action on the Hudson River in New York, the Hylebos and Thea Foss waterways in Washington, and the Kalamazoo River in Michigan.

By contrast, national and international engineered capping projects have been much smaller in scale and have only been implemented in the last 25 years. Table 3 of *White Paper No. 6B – In-Situ Capping as a Remedy Component for the Lower Fox River* contains a list of the comparatively few dredging projects that have been built, and monitored, only since 1984. Most of these projects are less than 50 acres.

Reference

Roukema, D. C., J. Driebergen, and A. G. Fase, 1998. Realisation of the Ketelmeer Storage Depot. *Terra et Aqua 71*. Website: http://www.iadc-dredging.com/terra%2Det%2Daqua/1998/71%2D3.htm.

Master Comment 8.5

Commenters expressed concern that dredging and the resultant resuspension of sediments have the potential to interfere with industrial processes requiring clean intake water. In addition, the proposed dredging schedule may interfere with commercial shipping and may affect shoreline stability, posing a risk to recreation, commerce, and the environment. Monitored natural attenuation reduces all these risks and is likely to be acceptable to the community.

Response

WDNR is unaware of any industrial water intake quality issues in the River associated with either navigational or environmental dredging projects on the Lower Fox River. The USACE performs regular navigational dredging on the lower portion of the River and the WDNR has not been notified of any problems from water users. Resuspension issues are discussed in Section 5.1.2 of this Responsiveness Summary.

On the two environmental dredging pilot projects performed on the River over the period 1998 through 2000, detailed monitoring of the River and of the water withdrawn by nearby industries had shown no degradation to the quality of water withdrawn for industrial uses. These industrial users were located very close to the dredging projects.

Commercial shipping on the River is confined to the lower few miles of the Lower Fox River. Dredging activities in the past for both navigation and for the environmental dredging pilot have been performed without interference to commercial navigation. WDNR and EPA have every reason to believe that future dredging projects can be implemented in a manner that fully accommodates commercial navigation. This is supported by the fact that dredging activities only impact a relatively small portion of the River at a single point in time.

Master Comment 8.6

Commenters suggested that remedial success based on mass removal effectiveness is misleading and that for the Lower Fox River the mass is diffuse and there are no “hotspot” areas.

Response

WDNR and EPA do not agree with the premise that, in the Lower Fox River, PCB mass is diffuse and widespread with no hot spots. The RI/FS clearly shows that the Lower Fox River does indeed contain hot spots; for example, Deposit A, Deposit POG, Deposit N, and SMU 56/57. Concentrations in these deposits range up to the hundreds of parts per million. Furthermore, this comment is misleading in that it suggests that the remedy is mass-driven when, in fact, the remedy is based on risk reduction.

Master Comment 8.7

A commenter stated that the FS did not use a “realistic solids content” for estimates in the FS. Based on the results from SMU 56/57, they argue that those levels should be 4 percent for the first pass and 2 to 4 percent for the second pass.

Response

WDNR and EPA agree that realistic dredge solids concentrations should be used in estimating production rates. The SMU 56/57 2000 project dredge solids concentrations ranged from 3.5 to 14.4 percent with an average of 8.4 percent. Since these concentrations reflect multiple passes, use of the 8.4 percent average for this project is a reasonable assumption. This value is similar to 5 of the 8 values submitted with Table 8 of the comment (FRG Comments, Volume 1, p. 252). The dredge sediment percent solids will be considered in greater detail during the design phase of the project.

Master Comment 8.8

Several comments were received concerning the use of silt curtains to control resuspension losses during dredging. These included comments that support the use of anchored silt curtains at all sites as is outlined in the FS. Other comments stated that silt curtains would be difficult to implement, not provide any additional protection, and have a poor application record at the demonstration projects.

Response

While the use of silt curtains were applied universally for the entire River in construction of the alternatives and costs, the FS did indicate that silt curtains may not be appropriate at all sites. As commenters correctly point out, currents, ability to anchor, obstructions, and interference with navigation uses, need to be considered with the final design. Silt curtains were applied throughout the FS as a general process option. Final determination on the need for or use of silt curtains in the Lower Fox River is a design issue and will be determined by the design engineer and dredge contractor.

Master Comment 8.9

Comments were received concerning the presence and importance of considering physical obstacles (water intakes, outfalls, piles, cables, pipelines, etc.) in planning for a remedial action. They submit that the FS and Proposed Plan did not evaluate the impact on the proposed remedy of any of these with regards to cost, effectiveness, and implementability.

Response

WDNR acknowledges that there will be physical obstructions in the downstream portion of the Lower Fox River that will need to be dealt with in any implemented remedial alternatives. The *Sediment Technologies Memorandum* documented that one of the important components that had to be built into remedy design is allowance for debris management. In the Draft FS, obstruction removal was not specifically accounted for. In the Final FS, the costs associated with debris sweeps have been specifically accounted for.

Master Comment 8.10

One commenter noted that it may not always be possible to use over-dredging or “overbite” to improve removal efficiency.

Response

WDNR agrees that it is not always feasible to use over-dredging to improve removal efficiency. However, as identified in the FS, over-dredging of sediments will be accomplished only when possible and necessary. There are several areas within the dredge footprint of the River, where sediments will be dredged to hard bottom, which eliminates the need for over-dredging. The residual contamination depends on a number of factors that include depth and type of materials underlying the dredge footprint, average PCB concentration of sediments, depth of cut, and cleanup goal for project. These conditions are site-specific and vary by projects. Results from the *Sediment Technologies Memorandum* (Appendix B of the Draft FS) indicate that dredging can be implemented in an effective way if the technology is designed and managed appropriately for the Site conditions. Recent advances in the dredge head construction and positioning technology enable accurate removal of sediment layers with minimum incidental over-dredging to achieve target goals. As stated in the FS, 17 of the 20 projects mentioned in Appendix B met the short-term target goals that includes sediment excavation to a chemical concentration, mass, horizon, elevation, or depth compliance criteria. Seven projects designed "over-dredge" into the project plans. In five out of seven cases, where over-dredge could occur, target goals were met.

Master Comment 8.11

Commenters believe EPA's final ROD should specify hydraulic suction dredging as the default sediment removal technology because:

1) Hydraulic dredging produces the lowest levels of sediment resuspension;

2) Hydraulic dredging can be engineered to minimize volatilization;

3) Hydraulic dredging works faster than mechanical dredging; and

4) The ability to pipe sediment slurry as far as 10 miles can reduce equipment traffic on the River and eliminate heavy truck traffic on regional roadways.

Response

WDNR agrees with the commenter that hydraulic dredging can be effectively used to control sediment resuspension, engineered to minimize volatilization, and connect to a sediment slurry line to minimize equipment traffic. Due to technical advancement, numerous improvements have been made to mechanical dredges (clamshell buckets) to limit the release of excavated sediments, thereby minimizing sediment resuspension. Due to unique characteristics presented by the River (bathymetry) and community (upland space for staging areas and processing areas), the Agencies are allowing flexibility in the implementation of dredging in order to allow the contractor the most efficient and cost-effective technology. Both hydraulic and mechanical dredging technologies have been demonstrated to provide a protective and environmentally beneficial result (FS Appendix B). Therefore, either technology is appropriate for removal of PCB-contaminated sediments from the Lower Fox River.

Master Comment 8.12

Commenters believe that a careful hydraulic dredging technique coupled with the use of silt curtains can minimize resuspension of contaminated sediment. The commenters stated that the long-term risks associated with the current annual loading of PCBs to Green Bay, if allowed to continue for an extended period, far outweigh the short-term risks associated with resuspension losses due to dredging.

Response

WDNR and EPA concur with the comment and believe that the commenters' opinion is consistent with the FS.

Master Comment 8.13

Commenters stated that the two dredging demonstrations recently done on the Lower Fox River showed that dredging can be effective at removing large volumes of sediment fairly quickly, with minimal drift downstream. However, the demonstrations also exposed several management problems that must be addressed before additional dredging is done:

1) Experienced operators must be hired.

2) Contractors must have clear guidelines and contracts to follow as established by the Agencies, and timelines and performance standards to meet with requirements for frequent reporting of progress and problems.

3) The government must retain oversight if the contractors are hired by the paper corporations.

4) Make sure the dredging starts on each sediment bed early enough to complete in one season, before the winter freeze-up of the River or Bay.

5) If a hotspot is too big to complete in one season, make sure the contractors slope the sides of the hole and cap the exposed edges for the winter to reduce the risk of toxic leakage between dredging seasons.

6) Make sure the contractors have multiple backup dredges and excess treatment capacity on land to compensate for unavoidable frequent equipment breakdown.

7) Have contractors dredge to below the sediment layers known to be contaminated to ensure they get all the toxics.

8) Even if the dredging results in some leakage downstream, the sediments are currently leaking 300 to 500 pounds of PCBs per year down the Lower Fox River.

Response

WDNR and EPA agree with the sentiments expressed in these comments. The Agencies will use pertinent comments as the design stage of this project is entered.

Master Comment 8.14

A commenter stated that the skills and technology are not available to remove nearly 9 million cy of sediment in the 7 years that the Proposed Plan estimates the entire dredging project will take to perform.

Response

First of all, the estimated volume of contaminated sediment to be removed from the River is estimated to by 7.25 million cy, not 9 million cy. It is expected that many of the dredging and mobilization activities will occur in parallel between operable units. WDNR will begin sediment sampling and analysis subsequent to issuance of a ROD, and will also initiate contractor selection. Contractor selection involves preparation of requests for qualifications followed by review of contractor submittals and then release of bid packages to qualified contracting teams. It is currently anticipated that there will be approximately 30 months available to accomplish remedial design; this is considered adequate time to complete the associated tasks.

Navigational dredging projects commonly dredge large volumes of sediment in a short timeframe. Typically, about 4 million cy of sediments are dredged by the USACE each year from Great Lakes harbors and channels. This is equivalent to 400,000 truckloads of soil. This is only a portion of the 300 to 350 million cy dredged by the USACE nationwide annually. On average, the USACE spends about $20 million annually for dredging and dredged material management in the Great Lakes basin (USACE's website: http://www.lrd.usace.army.mil/gl/dredge.htm, 2002). A project-specific example includes the White Rock Lake sediment dredging project, described in the Lower Fox River and Green Bay FS (Section 6) as the 20-mile-long pipeline project in Texas, hydraulically dredged 3 million cy of sediment in 1 year. Slurry solids content was 10 to 15 percent, comprised mostly of silt, clay, and debris. WDNR and EPA acknowledge that site conditions in the Lower Fox River are expectedly different from White Rock Lake, but for comparison purposes, this rate would equate to 7 million cy of sediment in 2.5 years. The Port of Los Angeles hydraulically dredged and landfilled about 29 million cy of sediment for the Pier 400 construction project (1994 through 2000). Minamata Bay, Japan and Lake Ketelmeer, Netherlands, two of the largest international contaminated sediment dredging projects (that WDNR and EPA know of) dredged 1 million cy of mercury-impacted sediment in 4 years and 1.9 million cy of impacted sediment in 1 year, respectively.

Factors that could create delays and downtime such as River congestion, weather, and equipment problems have been considered. Since productivity estimates applied in the FS were based on dredging equipment operating between 48 percent (mechanical) and 61 percent (hydraulic) of the week, considerable margin has been left to manage potential delaying factors such as those mentioned herein. WDNR believes that congestion problems can be avoided if project equipment movements are scheduled, as much as possible, for off-peak periods. Weather-related downtime includes delays from high flows, low temperatures, and high winds. After reviewing meteorological data, the potential for weather-related delays has been accounted for in the calculation of downtime. Finally, delays from equipment malfunctions and equipment unavailability need not represent major difficulties because extensive planning will occur at the outset of work and attention will be given to management of the overall remedial program.

8.2 Dredging Schedule and Production Rates

Master Comment 8.15

Commenters argued that the Proposed Plan's dredging rate estimates are too optimistic and are not typical of environmental dredging rates. The commenters argue that more appropriate rates would include 200 cubic yards per hour (cy/hr) for "first pass" dredging, and 100 cy/hr for "cleanup pass" dredging, which would also include 8 inches of over-dredged sediment. Based on their estimates, OU 1 would require 5.2 years for removal, OU 3 2.9 years, and OU 4 22.1 years. A key assumption was that only one hydraulic dredge can operate at each reach in order to minimize turbidity, TSS and PCB resuspension, and boat and ship traffic interference.

Response

There are two types of hydraulic dredges considered in the cost estimates for the Lower Fox River in the FS. The average dredge production rate for a 10-inch cutterhead dredge in a 10-hour shift is 105 cy/hr and the average dredge production rate for a 12-inch cutterhead dredge in a 12-hour shift is

120 cy/hr. These dredge rates are within the estimates used by the FRG model (100 to 200 cy/hr) to account for “first pass” and “cleanup pass” dredging.

The case studies presented in Appendix B of the FS indicate that the dredge rates in the Proposed Plan are not unreasonable for environmental dredging. For example, dredge production rates at the SMU 56/57 demonstration project averaged 60 cy/hr and 294 cy/day.

The commenter does not present the dredge production rates on the same basis. The commenter used different dredge equipment, sizing, and operating assumptions to derive the elongated schedule. For example, in OU 1 the FRG assumed 200 cy/hr for first pass dredging and 100 cy/hr for second pass dredging, operating 10 hours per day, 5 days per week, and 26 weeks per year. The resulting dredge duration is 681 days or 5.2 years. The FS assumed operating 10 hours per day, 5 days per week, and 26 weeks per year utilizing a 105 cy/hr dredge. This results in a total dredge timeframe of 5.7 years, slightly more than the FRG’s timeframe due to a lower dredge rate.

For OU 3, the FRG assumes one hydraulic dredge operating 12 hours per day, 6 days per week, and 26 weeks per year. This results in a dredge timeframe of 454 days or 2.9 years. The commenters’ argument that only one dredge can operate at any single time in either OU 3 or OU 4 is not a supportable position; there are no restrictions that prevent multiple dredges from operating in any OU. The FS describes two 12-inch cutterhead dredges operating simultaneously 12 hours per day, 7 days per week, 26 weeks per year, and a dredge rate of 240 cy/hr per dredge (840 cy/hr for two dredges). The resulting dredge duration is 102 days or 0.7 year, lower than the FRG’s timeframe due to a higher dredge rate.

Finally for OU 4, the FRG assumes one hydraulic dredge operating 12 hours per day, 6 days per week, and 26 weeks per year. This results in a dredge timeframe of 3,448 days or 22.1 years. The FS describes two 12-inch cutterhead dredges operating simultaneously 12 hours per day, 7 days per week, 26 weeks per year, and a dredge rate of 240 cy/hr per dredge (840 cy/hr for two dredges). The resulting dredge duration is 1,019 days or 6.8 years, lower than the FRG’s timeframe due to a higher dredge rate.

Master Comment 8.16

A commenter stated that the options for wastewater disposal are: (1) pre-treat water and discharge to a POTW (indirect discharge), or (2) complete treatment on Site and discharge directly to the River. The commenter expressed the opinion that both options are problematic; Appleton and Green Bay are the only two potential POTWs, and hydraulic and bioaccumulative/toxic impacts to POTWs make it a non-viable option.

Further, discharges to Appleton or Green Bay treatment works (largest in the area) would add approximately 100 and 500 percent, respectively, more wastewater – stretching or exceeding current operating capacities. Finally, the commenters stated that this wastewater could not be directly discharged to the River because of unwieldy facility size (the amount of water would be too great).

Response

The Proposed Plan does not recommend the discharge of sediment remediation wastewater to the Appleton, Green Bay MSD, or any other publicly owned wastewater treatment facility (WWTF). The Proposed Plan proposes to construct separate dedicated WWTFs with direct discharge to the Lower Fox River. Discussions with consultants and contractors with substantial experience designing, building, and operating these types of remediation projects have not identified the sizing, siting, and construction of WWTFs as a limiting factor. These issues must be considered for all projects and will be addressed in more detail during the design phase. The WDNR does not believe these issues threaten the viability of the Proposed Plan, and did not find any specific obstacles presented in the API Panel's or any other comments. Related issues are discussed in *White Paper No. 7 – Lower Fox River Dredged Sediment Process Wastewater Quality and Quantity: Ability to Achieve Compliance with Water Quality Standards and Associated WPDES Permit Limits*.

Please also see response to Master Comment 5.52 through 5.60.

Master Comment 8.17

The commenters stated that the dredging recommended in the Proposed Plan was not viable because the quality and quantity of wastewater generated in the dredging process could not comply with water quality standards and associated WPDES permit limits, even using the most advanced wastewater treatment process. The wastewater quantity and quality limitations would, therefore, restrict the allowable wastewater discharge rate, thereby decreasing the allowable dredging rate and increasing the dredge schedule from the 7 years estimated in the Proposed Plan to as much as 60 years. Based on these assumptions, the commenters concluded that in-place sediment capping was the only viable alternative for remediation of the Lower Fox River sediment.

Response

In response to these comments, the WDNR analyzed the assumptions used to support the comment conclusions and performed an evaluation to determine if the expected dredge process wastewater characteristics and volumes would restrict or limit the viability of the Proposed Plan as claimed in the comments. The complete analysis is presented in *White Paper No. 7 – Lower Fox River*

Dredged Sediment Process Wastewater Quality and Quantity: Ability to Achieve Compliance with Water Quality Standards and Associated WPDES Permit Limits.

This analysis concluded that the dredge process wastewater quantity and/or quality do not restrict the viability of dredging as recommended in the Proposed Plan, and do not, by themselves, justify the API Panel's alternative capping proposal. This evaluation essentially concludes that the expected quality and quantity of the dredge process effluent will comply with Water Quality Based Effluent Limits (WQBEL), and will not restrict the effluent discharge rate or associated dredge schedule. The expected effluent quality and quantity do not therefore limit the viability of the proposed remedial dredging project.

Additional significant specific conclusions from *White Paper No. 7 – Lower Fox River Dredged Sediment Process Wastewater Quality and Quantity: Ability to Achieve Compliance with Water Quality Standards and Associated WPDES Permit Limits* include:

- The wastewater quality achieved from the Lower Fox River Deposit N and SMU 56/57 demonstration projects provides the best representation of the effluent quality expected from the full-scale dredging of the Lower Fox River. These data should be used for estimating expected effluent quality, not those assumed by the commenters.

- Effluent quality would not limit the ability of the project to comply with expected wastewater WPDES permit limits.

- Effluent quality would not restrict the expected effluent discharge rate based on the Lower Fox River assimilative capacity for cadmium, dieldrin, endrin, mercury, or any other parameter.

- The WQBEL for toxic and organoleptic compounds regulated under WAC NR 106 are only needed for PCBs and mercury.

- PCBs and mercury WQBELs will be determined using the alternative limit procedures provided in NR 106.06(6), because background Lower Fox River concentrations of PCBs and mercury exceed water quality standards.

- The Lower Fox River assimilative capacity for BOD is indeed fully allocated, however, much of that capacity is unused by the permitted discharger. Effluent from full-scale implementation of the proposed dredging plan would only use a small portion (less than 10 percent) of the unused or available assimilative capacity of the River.

- A significant portion of unused capacity is held by the PRPs and can be formally or informally reallocated to the discharge of the remediation project.

- Effluent quantity estimates contained in the comments are not reasonable, do not limit the allowable dredge rate, and would not extend the dredge schedule beyond that estimated in the Proposed Plan.

- Discharges from two pilot dredging projects have been permitted under Wisconsin regulations.

Master Comment 8.18

Commenters expressed concerns that the proposed remedy could not be completed according to the timeframe described in the FS and Proposed Plan. Dredging rate assumptions are higher than dredging rates achieved on the best days of both the 1999 and 2000 demonstrations projects at SMU 56/57.

Response

The dredging rates proposed for the Lower Fox River were determined based on site-specific dredging rates produced from the Lower Fox River demonstration projects at Deposit N and SMU 56/57. These rates were reviewed by nationally recognized dredging engineers and contractors and applied to the FS. WDNR recognizes that the Proposed Plan for large-scale dredging of the Lower Fox River constitutes one of the largest environmental dredging projects in the United States, but the volumetric scale of dredging is not unusual for navigational projects typically and annually conducted in the United States by the USACE. Careful coordination of dredging, dewatering, and disposal parameters will be refined during the pre-remedial design phase to meet the timeframe desired by WDNR.

The dredge production rates were determined based on experience with previous dredging projects and consultation with experienced dredge contractors. Downtime of approximately 17 percent has been factored into the dredge production rates. The dredge production rate specified for hydraulic dredge with cutterhead in the Draft 2001 RI/FS is 1,050 to 1,200 cy/day. The case studies presented in Appendix B of the FS indicate that the proposed dredge rates are not unreasonable for environmental dredging. The dredge production rate from both Lower Fox River demonstration projects was considered and evaluated throughout the drafting and finalizing of the FS. Other considerations included an examination of physical sediment conditions throughout the entire River (e.g., grain size, *in-situ* bulk density). Finally, considerable experience at other sites was considered in setting the final dredging rates for the FS (e.g., the case studies in the *Sediment Technologies Memorandum*).

Master Comment 8.19

A commenter argued that since PCBs were discharged in a dissolved/emulsion form they continue to partition between water and sediments, which causes dispersal and minimizes “hot spots” (vs. pure-phase discharged to the Hudson River, for example).

Response

WDNR and EPA disagree with this assessment. Furthermore, it is not relevant what phase the PCBs are in when discharged into the River. The RI identifies numerous deposits of soft sediment with elevated PCB concentrations. PCBs continue to pose an unacceptable risk and are continuing to bioaccumulate in fish.

8.3 Dredge Material Disposal

Master Comment 8.20

Commenters offered the observation that if placing contaminated sediment into a landfill met serious public resistance, potentially sediment would have to be shipped out of state for disposal, causing costs to be prohibitive. The commenter further stated that no options for siting the pipeline or selecting preferred/recommended routes for conveyance of dredged sediment were included in the FS and that trucking is prohibitive if pipeline siting cannot be agreed upon.

Response

The WDNR agrees that the tipping and transportation costs would be costly if dredged sediments had to be transported and disposed of out of state. However, recognizing the passage of resolutions by almost every city council and county board in the Fox River Valley supporting a local solution to the problem, WDNR and EPA do not see this scenario playing out. Local landfills with sufficient capacities exist. Furthermore, there is interest by local landfills to contract for the disposal of these sediments as they represent a secure stable waste stream and business opportunity for a longer period of time. With the purchase of the abandoned railroad right-of-way for the Fox River Trail, the option of locating a pipeline to transport dredged sediments to potential landfill sites in the Town of Holland area is completely feasible. The state had the foresight to negotiate use of the trail’s right-of-way; locating another route for the pipeline would have been difficult, time intensive, and costly.

The WDNR also agrees with the statement that a local solution is critical to keeping costs down.

Master Comment 8.21

A commenter suggested that lime, used for stabilization of dewatered sediments, was not factored into the disposal sediment tonnage estimate.

Response

As part of the pre-design testing for the pilot dredging project at SMU 56/57, bench-scale solidification tests were conducted to evaluate the performance of various additives for solidification. Based on the bench-scale solidification test results, it is apparent that a 10 percent by wet weight high-calcium pebble lime mix results in almost no increase in total weight after solidification. This is attributed to the water vapor loss caused by heat of hydration ($CaO + H_2O$) when lime is mixed with wet sediments.

It should also be noted that lime addition is not necessarily needed. During the 2000 dredging project at SMU 56/57, the dredged sediments did not need any further stabilization (no lime was added) to be acceptable for disposal. Therefore, it is not necessary to include additional tonnage into the disposal estimates.

Master Comment 8.22

A commenter, Minergy Corporation, provided detailed information on the status of the an update on the status of the GFT feasibility project being conducting by the company in cooperation with WDNR, the EPA Superfund Innovative Technology Evaluation (SITE), and EPA Great Lakes National Program Office (GLNPO). Minergy indicated this technology was an appropriate thermal treatment technology that should be considered in the FS. The GFT information included:

- Expected emissions from a full-scale operation would be very low, including a stack-basis destruction of PCBs of greater than 99.9999 percent.

- The annual PCB emissions in the stack would equate to 1.58 grams per year or 0.0035 pounds per year. This is only 3.5 percent of the WAC Section NR 445 Table 3 values for PCB emissions. Therefore, no additional study for the economic and technical feasibility for additional controls will be necessary at this emission level.

- The GFT provided net destruction of dioxin. Dioxin (2,3,7,8-TCDD) was not detected in the final exhaust after the air quality control equipment. Some dioxin/furans were detected in the exhaust gases prior to the air quality control equipment; however, they were clearly present in the sediment.

- Treatment of the sediment is cost-effective. Unit costs were estimated to be between \$25 and \$50 per ton of dewatered sediment (50 percent solids), which are less than the disposal costs from both pilot dredging projects.

Response

WDNR and EPA agree that GFT is potentially a feasible alternative for management of dredged material. Based on the information submitted documenting the results of the pilot-scale testing of the GFT, WDNR modified text within the FS to incorporate this technology (and the results of the pilot project). GFT was then carried forward in the FS as the representative process option for thermal treatment of sediment in lieu of high-temperature thermal desorption (HTTD). Cost estimates were revised for this alternative based on this information.

Master Comment 8.23

Commenters expressed concern that the Proposed Plan presentation is difficult to comment on. For instance, the reference to an unnamed landfill and the use of some kind of public right-of-way to run a pipeline from the Lower Fox River to the landfill seem intentionally vague.

Response

WDNR and EPA believe that the level of detail presented in the Proposed Plan and accompanying FS are appropriate for this point in the project process. Identification of the actual landfills accepting the sediment, transportation routes for either trucks or a pipeline are issues that are to be addressed in the remedial design phase of the project following issuance of the ROD.

Master Comment 8.24

Commenters indicated their preference that PCB hotspot sediments with higher concentrations be detoxified permanently using non-incineration, closed-loop technologies.

Response

The FS evaluated over 100 different technologies that could be applied to remediation of the Lower Fox River sediments. Of the technologies evaluated, there were no applicable and practical technologies that would allow for detoxification using non-incineration, close-looped technologies. WDNR and EPA duly note the commenter's preference of both treatment of the more highly contaminated sediments and closed-loop non-incineration technology.

Master Comment 8.25

Commenters recognized and accepted that a large volume of landfill space will be necessary to dispose of the lower-concentration PCB-contaminated sediments dredged from the River and Bay. They further stated that these landfills must be state-of-the-art landfills in full compliance with state and federal laws.

Response

The WDNR and EPA agree with this comment. Any landfill accepting contaminated sediment from the Lower Fox River will be licensed under applicable state and federal laws.

Master Comment 8.26

Commenters recognized and accepted the necessity for a sediment slurry pipeline to transport dredge spoils to landfill disposal sites.

Response

The WDNR and EPA agree with this comment.

Master Comment 8.27

Commenters indicated their preference for closed-loop PCB destruction technologies and their use for sediments with greater than 50 ppm PCBs. They favored the Eco-Logic process citing that burning, melting, or incineration technologies must not be used due to the likely formation of dioxins and furans and the high potential for release of co-contaminants (mercury and lead).

Response

Data generated by the EPA Superfund Innovative Technology Evaluation program shows that thermal treatment technologies like vitrification do not generate dioxins and furans in the off gases from these technologies. Further, WDNR and EPA do not agree with the commenters' assertions that properly engineered and operated pollution control equipment does not reduce emissions of heavy metals to regulated levels.

Master Comment 8.28

Commenters offered that WDNR and EPA should not assume the availability of local landfill capacity.

Response

Landfills with sufficient capacities exist in close proximity to the Lower Fox River. Furthermore, there is interest by local landfills to contract for the disposal of these sediments as they represent a secure, stable waste stream, cash flow, and business opportunity for a long period of time. WDNR and EPA also recognize the passage of resolutions by almost every city council and county board in the Fox River Valley calling for and supporting a local solution to the problem. Thus, WDNR and EPA believe that the facility can be located, consistent with the assumptions used for evaluation of the selected remedy in the ROD.

Master Comment 8.29

Commenters noted that the most cost-effective means of landfilling dredged sediments may involve the siting and construction of a new landfill. The commenter is concerned that this key issue could significantly delay the remediation plan. Another commenter noted that the treatment and disposal of sediments will require development of substantial infrastructure, which will restrict productivity and extend the dredging project timeline.

Response

The dredging, treatment, and disposal of sediments will require a substantial infrastructure and timeframe to in place for the management, treatment, dewatering, and disposal of dredged sediments. The WDNR recognizes the key to making this all come together relies on several factors:

- Contracting with qualified/competent contractors with the experience and proven track record in conducting projects of this magnitude. (The WDNR witnessed the importance of this in its two demonstration projects.)

- Successfully negotiating with existing licensed local public and private landfill owner/operators for disposal of the sediments. Utilizing existing landfills or ones that are partially through the siting process will expedite sediment disposal. (The WDNR has been approached by different area landfills with an interest in taking sediments. Similarly, members of the FRG that have landfills may offer disposal capacity as part of their settlements, similar to what Fort James did in the SMU 56/57 demonstration project.)

- Dedicating WDNR plan review staff to expedite plan reviews linked to the Lower Fox River to ensure permits and licenses are issued in a timely manner.

- Managing the overall River cleanup in smaller, more manageable units. (The timeframe for completing the removal and/or capping of the sediments spans more than a decade.) Staging dredging and capping projects accordingly can develop the needed infrastructure over time.

- Successful management and oversight to ensure contractors and consultants are meeting project and contract expectations.

The same concerns are applicable to capping or any other remedial approach to an environmental project of this size.

Master Comment 8.30

A commenter noted that with construction of a pipeline, there are necessary institutional and community concerns. They recommend that WDNR initiate planning for this issue jointly with efforts for establishing a viable landfill location(s) as soon as possible.

Response

WDNR and EPA agree with this comment and plan to utilize an experienced expert technical review team to further assess the planning, operation, and construction of the pipeline and disposal facility.

Master Comment 8.31

A commenter offered their preference to use innovative technologies for treatment so as to minimize landfilling of contaminated sediment.

Response

Comment noted.

8.4 Safety Concerns and Community Concerns

Master Comment 8.32

Commenters felt that sediment handling and treatment is as crucial as proper removal and urged the WDNR to take appropriate precautions to control volatilization.

Response

Based on the results of the air monitoring conducted during the dredging project at SMU 56/57 (WDNR, 2000), volatilization of PCBs to the atmosphere are not likely to be a risk to the surrounding communities. Clearly, during remediation of the most highly contaminated sediments in the entire Lower Fox River, volatilization did not reach a level that posed a risk to human health. The FRG (BBL, 2000) concluded that: "Although increases in ambient air PCB concentrations were observed near the sediment dewatering area, estimated PCB emissions and resulting concentrations were found to be relatively small and insignificant relative to human exposure and risk." The highest concentration recorded on site is less than 80 percent of the conservative risk level while off-site risks never exceeded 4 percent. In any case, the identification and use of control measures to minimize volatilization will be addressed during the remedy design activities following issuance of the ROD.

References

BBL, 2000. Major Contaminated Sediment Site Database. Last updated August 1998. Website. http://www.hudsonwatch.com.

WDNR, 2000. *Post-Dredging Results for SMU 56/57*. Memorandum prepared by Bob Paulson. Wisconsin Department of Natural Resources, Madison, Wisconsin. February 21.

Master Comment 8.33

A commenter observed that significant questions exist as to the feasibility of massive dredging such as whether equipment can be staged in appropriate areas and whether disposal sites will be available. The commenter suggested that the FS and Proposed Plan contain no analysis of the feasibility of the proposed twin 28-mile slurry pipeline, including permitting and the likely local opposition to a pipeline that could carry dredged slurry through residential areas.

Response

For the purposes of the FS, potential locations were identified based on screening-level field observations from an engineering perspective. In the FS, it was necessary to identify potential locations of support facilities to analyze equipment requirements, and develop conceptual engineering plan and cost estimates for the remedial alternatives. The locations selected in the FS are representative of reasonable assumptions with regard to distance from the dredging work and related costs. The final location(s) of these facilities will be determined during the project's design stage. Additional analyses will be performed to determine more information about the proposed facilities and public comment/input will be considered in the final facility sitting decision.

Master Comment 8.34

Commenters noted that limited River access, high truck traffic, residual sediment PCB concentration, and treatment requirements will make a full-scale dredging project difficult, prolonged, and costly; equipment would have to be transported by truck to get an adequately large dredge to the Site (a small dredge would not reach depth, temporarily exposing high concentrations).

Response

There are several points to this comment. First of all, these issues are germane whether a dredging or a capping plan were selected. For both options, truck traffic, River access, residual surface concentration, equipment transportation, etc., are also important considerations that need to be dealt with. In one case, large quantities of material are brought to the River and that material needs to be spread on the River bottom and in the other scenario, material is removed from the River bottom and has to be taken off-site.

Master Comment 8.35

Commenters noted that the public should be informed that the Proposed Plan would cause significant noise, intrusive artificial lighting, and stress on existing transportation systems. The commenters noted that all reasonable steps should be taken to minimize the negative impacts of remediation on host communities including noise control, limited nighttime light pollution, the use of a pipeline rather than truck transportation, and minimization of outdoor material handling.

Response

WDNR and EPA agree with the commenter that impacts to communities where staging of the remedial action or disposal of the sediment is to occur should be minimized to the extent practicable. The Agencies believe that this can be accomplished given the successful completion of dredging projects at both Deposit N and SMU 56/57. Community relations and concerns will be addressed during design of the remedy, following issuance of the ROD.

Master Comment 8.36

Commenters felt that the Proposed Plan failed to address onshore contamination concerns of shoreline property owners.

Response

Given the geographic and topographic features of the Lower Fox River, there are no large floodplain areas. In a few cases, small amounts of dredged material from the River have been used as fill in upland areas. In these cases, the residual PCB contamination is being addressed as part of the site-specific upland investigation and remediation. In Green Bay, concentrations within the Bay do not appear to be sufficient to create shoreline contamination at levels of concern. Based on limited sampling, there have been no indications that the shoreline is contaminated. Furthermore, this observation is inconsistent with the nature of the industrial processes that caused contamination in the River (discharge of wastewater).

Master Comment 8.37

A commenter offered that, in their opinion, the dredging schedule currently requires around-the-clock trucking to transport dewatered sediments from OU 1, causing serious traffic density, highway safety, and aesthetics issues.

Response

WDNR and EPA disagree with the opinions offered by the commenter. Three dredging projects (the ongoing navigational dredging, the Deposit N project, and the SMU 56/57 project) have been successfully completed on the Lower Fox River that did not encounter any of the problems the commenter cites. Further, at the dredging projects at Deposit N and SMU 56/57, trucking was not required around the clock to effectively remove the sediments to the landfill. These issues are more appropriately resolved during remedial design following issuance of the ROD.

Master Comment 8.38

Commenters offered that PCBs will volatilize to the air, but the Proposed Plan fails to account for this in its analysis of the protectiveness or effectiveness of dredging. The commenters suggested that although PCBs are highly hydrophobic chemicals that, when placed in aquatic environments, tend to become sorbed to organic matter and sediment, a very small portion of the PCB mass in an aquatic system exists in the water column, either adsorbed to water column organic matter or in a freely dissolved state. Some portion of freely dissolved PCBs can volatilize into the atmosphere.

Response

As demonstrated by WDNR's Urban Air Toxics Monitoring (WUATM) program, atmospheric levels of PCBs are already elevated in the Green Bay area. These findings were confirmed during the GBMBS where researchers estimated that during the 1989/1990 study period, approximately 154 kg of PCBs volatilized from the surface of Green Bay. Further, an additional 24 kg were estimated to have volatized from the surface of the Lower Fox River. Although elevated PCB levels have been documented, as illustrated in the BLRA, these levels do not pose an unacceptable risk.

Air concentrations of PCBs were also monitored during the dredging project at SMU 56/57 (WDNR, 2000). The general design of the project deployed samplers along a grid surrounding the project site and work areas to collect samples for spatial analysis. The grid was intended to provide upwind and downwind locations for each sampling event. Monitoring was conducted throughout the duration of the 2000 dredging project. An outer ring of samplers was established approximately 2 km from the project site while a second inner ring was located approximately 1 km away. The remaining samplers were deployed 250 and 500 meters from the center of the project site. The closest samplers were on the project site, directly adjacent to both the dewatering basins and presses. A conservative ambient level of concern was established at 100 ng/m^3, which equates to a 10^{-5} cancer risk.

Ambient concentrations observed during the 24-hour sampling regime ranged from less than 0.2 ng/m^3 to 79.7 ng/m^3 during the dredging and sediment processing. Ambient concentrations within the property boundaries of the remediation area ranged from approximately 0.7 ng/m^3 to 79.7 ng/m^3 while off-property concentrations reached a maximum of only 3.6 ng/m^3. The highest concentration recorded on site is less than 80 percent of the conservative risk level while off-site risks never exceeded 4 percent.

Clearly, during remediation of the most highly contaminated sediments in the entire Lower Fox River, volatilization did not reach a level that posed a risk to human health. The FRG (BBL, 2000) even concluded that: "Although increases in ambient air PCB concentrations were observed near the sediment dewatering area, estimated PCB emissions and resulting concentrations were found to be relatively small and insignificant relative to human exposure and risk."

As stated above, remediation at SMU 56/57 removed the most highly contaminated sediments in the entire River. Based on the reported mass (654 kg) and *in-situ* sediment volume removed (31,500 cy), sediments at SMU 56/57 averaged 20.8 grams per cubic yard (g/cy). In contrast, the Proposed Plan averages only 4 g/cy (29,259 kg/7.25 million cy). Even if one assumes a volatilization rate equal to that observed during the dredging project, the sediments to be handled during the entire remediation are less than one-fifth as concentrated, so the mass of PCBs lost during the entire remediation period (125 kg) would be less than that estimated for just 1989/1990 during the GBMBS (154 kg).

References

BBL, 2000. Major Contaminated Sediment Site Database. Last updated August 1998. Website. http://www.hudsonwatch.com.

WDNR, 2000. *Post-Dredging Results for SMU 56/57*. Memorandum prepared by Bob Paulson. Wisconsin Department of Natural Resources, Madison, Wisconsin. February 21.

Master Comment 8.39

Comments were submitted that listed several concerns regarding volatilization of PCBs into the air and the commenters' opinion that this issue is a seriously neglected concern regarding human health. The commenters offered that volatilization should be prevented, to the extent practicable, through enclosing all sediment processing and wastewater treatment systems, including handling, transport, and landfill systems.

Response

WDNR and EPA recognize the potential loss of PCBs through atmosphere during removal, handling, and disposal of River sediments. However, the identification, use, and implementation of control measures to minimize volatilization is more appropriately addressed during the remedy design activities following issuance of the ROD. In addition, air monitoring will be incorporated into the various on-water and upland activities during implementation to address community and workers' concerns.

Recognizing the results of the air monitoring conducted during the dredging project at SMU 56/57 (WDNR, 2000), the Agencies have determined that activities associated with implementing the Proposed Plan will not result in unacceptable risk as a result of PCB losses to the atmosphere. Ambient concentrations observed during the 24-hour sampling regime ranged from less than 0.2 ng/m^3 to 79.7 ng/m^3 during the dredging and sediment processing. Ambient concentrations within the property boundaries of the remediation area ranged from approximately 0.7 ng/m^3 to 79.7 ng/m^3 while off-property concentrations reached a maximum of only 3.6 ng/m^3. The highest concentration recorded on site is less than 80 percent of the conservative risk level while off-site risks never exceeded 4 percent. Sampling adjacent to the landfill accepting the dredge material from SMU 56/57 indicated that 29 of 31 samples had no detectable PCBs. The two samples that did show detectable PCBs were not significantly different from background samples also collected in the area.

Clearly, during remediation of the most highly contaminated sediments in the entire Lower Fox River, volatilization did not reach a level that posed a risk to human health. The FRG (BBL, 2000) even concluded that: "Although increases in ambient air PCB concentrations were observed near the sediment dewatering area, estimated PCB emissions and resulting concentrations were found to be relatively small and insignificant relative to human exposure and risk."

As stated above, remediation at SMU 56/57 removed the most highly contaminated sediments in the entire River. Based on the reported mass (654 kg) and *in-situ* sediment volume removed (31,500 cy), sediments at SMU

56/57 averaged 20.8 g/cy. In contrast, the proposed remedial plan averages only 4 g/cy (29,259 kg/7.25 million cy). If one assumes a volatilization rate equal to that observed during the dredging project, the sediments to be handled during the entire remediation are less than one-fifth as concentrated and therefore the mass of PCBs lost during the entire remediation period (125 kg) would be less than that estimated for just 1989/1990 during the GBMBS (154 kg).

References

BBL, 2000. Major Contaminated Sediment Site Database. Last updated August 1998. Website. http://www.hudsonwatch.com.

WDNR, 2000. *Post-Dredging Results for SMU 56/57*. Memorandum prepared by Bob Paulson. Wisconsin Department of Natural Resources, Madison, Wisconsin. February 21.

9 Selection of Remedy

9.1 General Comments

Master Comment 9.1

Commenters stated that a reduction of PCB mass does not necessary cause equivalent reduction in exposure or risk to biota and that dredging may disperse buried PCBs increasing short-term risk. The commenters go on to say that risk reduction should be the ultimate goal of any sediment management activity.

Response

WDNR and EPA agree that risk reduction should be the ultimate goal of any sediment remediation project whether that activity is a MNR, capping or removal program. However, the remedy selected for OU 1 is not a mass removal activity. The selected remedy is risk based in that the residual SWAC based on the RAL of 1 following remediation will result in significant risk reduction. The Agencies also realize that active remediation will result in a small (2.2 percent) amount of resuspension of contaminated sediments. Furthermore, if no action is taken in OU 1, then there will continue to releases of PCBs from contaminated sediment.

Master Comment 9.2

Commenters stated that background conditions and technical impracticability will frustrate achievement of fish tissue concentrations for high-intake consumers because background levels in Lake Winnebago fish tissues result in fish consumption advisories. The commenters also stated that atmospheric PCB deposition contributes to background concentrations.

Response

The commenters are correct in that fish consumption advisories exist for Lake Winnebago. These advisories however are less stringent than those for the Lower Fox River and Green Bay. For instance in Little Lake Butte des Morts and the rest of the lower Fox River, all sizes of carp are “Do Not Eat” and there are no species of fish that can fall into the “unlimited” or “once per week” consumption categories. However, the Lake Winnebago advisories allow for much more frequent consumption of most species (“unlimited” or “once per week”) and only limit large carp and large channel catfish consumption to 12 meals to year. There are no “Do Not Eat” or “Eat no more than six meals per year” restriction in Lake Winnebago.

The Agencies agree that atmospheric deposition contribute to background concentrations.

Master Comment 9.3

Commenters indicated that dredging 8.95 million cy of sediment from the Lower Fox River which removes two-thirds of total volume of sediment in the River is not the right solution.

Response

The Proposed Plan does not recommend removal of 8.95 million cy of material. The plan calls for the removal of approximately 7.25 million cy. Regardless, based on careful consideration of all data and an evaluation using the nine evaluation criteria in the NCP, WDNR and EPA have determined that removal and disposal of approximately 780,000 cy of contaminated sediments in OU 1 is protective, implementable, and cost-effective. Sediments in OUs 3 through 5 will be considered in another ROD.

Master Comment 9.4

Commenter stated that when using different models, the remedy from the Proposed Plan does little to reduce projected human health risks and that changes to numerical risk estimates are minor and are not significant, given the uncertainty of the analysis.

Response

WDNR and EPA disagree with the foundation of this statement; that the models used in the RI/FS are flawed. Over the years, WDNR has worked cooperatively and collaboratively to develop the models that can be used as a tool to assist in decision making on this project. The Agencies' primary model is wLFRM. This model was initially developed as part of the Green Bay Mass Balance Study (GBMBS) as part of a suite of coupled water quality models describing PCB transport in the Lower Fox River and Green Bay were developed. Since the end of the GBMBS, efforts to examine and assess the performance of Lower Fox River water quality models have continued. Four generations of water quality model development have been initiated. The model developed as part of RI/FS efforts is the result of continued assessments of Lower Fox River water quality model performance and represents the fourth generation of model development. To distinguish this model from prior generations of development, this fourth generation model is identified as the "whole" Lower Fox River model (wLFRM).

Development of the wLFRM was based on the results of a 1997 agreement and a peer review of model performance with the Fox River Group (FRG). A component of the agreement was to evaluate water quality models for the Lower Fox River and Green Bay with the intent of establishing goals to evaluate the quality of model results and a Model Evaluation Workgroup was formed. The Workgroup was comprised of technical representatives for the FRG and WDNR in order to undertake "cooperative and collaborative" evaluations of model performance. Development of a series of technical reports followed. The series of reports developed by the Workgroup were each prepared as a Technical Memorandum (TM) and are included in the Model Documentation Report. . The TMs provide detailed analyses of key aspects of model development such as solids and PCB loads, sediment transport dynamics, and initial conditions.

In addition to the Workgroup efforts, a peer review panel presented additional assessments of model performance. To the greatest extent practical, peer review panel recommendations were integrated into wLFRM development efforts. The wLFRM describes PCB transport in all 39 miles of the Lower Fox River from Lake Winnebago to the River mouth at Green Bay in a single spatial domain.

More information on wLFRM development can be found in the Model Documentation Report which was prepared as a supporting document to the RI/FS and in *White Paper No. 16 – wLFRM Development and Calibration for the Lower Fox River/Green Bay Remedial Investigation, Feasibility Study and Proposed Remedial Action Plan*.

The models used to support these claims do not appear to have been subject to same degree of scientific scrutiny and peer review as was wLFRM. WDNR did review the FOXSIM model and the conclusions of that review can be found in *White Paper No. 15 – FoxSim Model Documentation*.

More information on how the Agencies used the models in making our decision can be found in *White Paper No. 9 – Remedial Decision-Making in the Lower Fox River/Green Bay Remedial Investigation, Feasibility Study and Proposed Remedial Action Plan.*

Master Comment 9.5

Commenters stated that mass removal of PCB-contaminated sediment will improve the health of the ecosystem and provide greater protections for public health.

Response

WDNR and EPA have chosen a remedial approach based on risk reduction. Given the circumstances of the Lower Fox River, this approach also results in the significant PCB mass removal.

Master Comment 9.6

A commenter suggested that the local governments support an immediate and intensive negotiation process to provide the funding and other commitments necessary to allow remedial action to commence promptly.

Response

WDNR and EPA will have discussions with PRPs concerning their implementation of the selected remedy. Any local support that can expedite implementation of the remedy is appreciated.

Master Comment 9.7

A commenter offered that cleanup work must begin as soon as possible. The commenter wanted multiple dredging crews working simultaneously at several sites along the River and in the Bay to ensure the cleanup progressed as quickly as physically possible.

Response

WDNR and EPA would also like to see active in-water remediation take place quickly. Toward that end, WDNR and EPA have conducted the pilot projects to demonstrate that dredging can be done on the River in an effective fashion with minimal disruption of industry or the community. While the ROD only determines a cleanup plan for OU 1, it is recognized that expediting activities in OU 1 and possible work in other OUs is highly desirable.

Master Comment 9.8

A commenter observed that natural and anthropogenic forces acting on the River and the Bay, the permanence of any solution, and the need for long-term monitoring should all be considered when evaluating remediation options.

Response

WDNR and EPA agree with this comment and believe these items have been considered in the selection of a remedial alternative.

Master Comment 9.9

Commenters stated that PCBs will remain toxic for centuries and there are no guarantees about the future stability of human society in this area considering how much has changed in the past 150 years.

Response

PCBs are very persistent, are readily passed along in the food chain, and will continue to pose human health and ecological for years to come. The Agencies believe the most effective way to permanently address this situation is to reduce or eliminate the exposure pathway through the implementation of the selected remedy for OUs 1 and 2. This will involve active removal of contaminated sediments, where necessary, to achieve the risk reduction and to appropriately managed the dredge materials in such a way that they do not pose a threat. Landfilling of dredged material is an effective way to isolate those materials.

9.2 Cost

Master Comment 9.10

Commenters wrote that the PCB problem has been stated too generically, with inadequate precision to lead to a technically appropriate, cost-effective solution.

Response

In preparing the RI/FS, the Proposed Plan, and the ROD, WDNR, with assistance from EPA, followed all the appropriate guidance for completing these documents. The level of detail afforded these documents is consistent with what guidance says for this juncture of the Superfund process. At this point, cost estimates are expected to be within -30 and +50 percent. It is important to recognize that this is the point where WDNR and EPA are selecting an option, not formally adopting a fully designed engineering remediation plan. With the completion of the ROD, WDNR and EPA will proceed with negotiation of a Consent Decree with the responsible parties at which time a detailed engineering design will be completed.

Master Comment 9.11

Commenters stated that the cost of the dredging identified in the Proposed Plan is seriously underestimated and misleading and that other alternatives would cost less. The three new alternatives cost less than the remedy proposed in the Proposed Plan as they address less sediment volume.

Response

WDNR and EPA strongly disagree with the comment, which states that the cost estimates proposed for dredging in the Proposed Plan is underestimated and misleading. The detailed cost estimate for Lower Fox River and Green Bay presented in Appendix H of the FS was developed based on cost estimates from previous projects for dredging. Landfill capacity, costs, and disposal costs in Wisconsin were determined and included in the cost estimates. WDNR and EPA also believe that a local solution is a key to keeping costs from increasing.

As stated in Appendix B of the FS, the total dredging cost per cubic yard for 17 projects reviewed ranged from approximately $6 to $507 per cy. The dredging cost per cubic yard generally decreased as the volume of sediment to be removed increased (regardless of removal method). It is apparent that the dredging unit costs developed in the FS are within the range of the unit costs represented by the 17 projects. Also, implementation at projects like Oakland Harbor was performed at unit costs comparable to the costs in the FS.

Master Comment 9.12

Commenters expressed their position that the total estimated cost of approximately $300 million is a reasonable expenditure that will reap significant environmental benefits.

Response

The Agencies agree that the costs estimated are reasonable and will provide a protective remedy with significant benefits. As part of WDNR's and EPA's evaluation of comments on the RI/FS and Proposed Plan, the costs associated with the 1 ppm cleanup level were reviewed again. The cost estimate to implement the remedy is now estimated at $76.10 per cy. This is within a small percentage of the amount in the Proposed Plan. WDNR and EPA believe that the cost of conducting the remediation and monitoring activities are within Superfund guidance criteria of -30 to +50 percent for purposes of cost estimations. For the phase WDNR and EPA are at in the Superfund process, this is an acceptable range per federal Superfund guidance. It is quite likely that this money will have a direct positive effect on the local economy.

Master Comment 9.13

Commenters noted that there are benefits associated with moving forward with the cleanup, and stated that remediation is a good investment and that delays could reduce the effectiveness of the remediation effort with no reduction in cost now.

Response

WDNR and EPA agree. Moving forward with remediation in the River will begin to reduce the risks and result in a lower overall cost compared to delaying action. However, WDNR and EPA are constrained by legal and administrative requirements that laws and regulations require be observed.

Master Comment 9.14

Commenters stated that WDNR should do whatever possible to create a sense of certainty relating to the proposed costs of remediation for the Lower Fox River and Green Bay.

Response

In preparing the cost estimates included in the FS, WDNR and EPA followed the appropriate guidance for completing these estimates found in Appendix H of the FS. The level of detail is consistent with guidance, which calls for cost estimates to by within -30 and +50 percent. It is important to recognize that this is the point at which WDNR and EPA are selecting an option, not formally adopting a fully designed engineering remediation plan. With the completion of the ROD, WDNR and EPA will not proceed with negotiation of a Consent Decree with the PRPs at which time a detailed engineering design will be completed. A detailed design will allow for more detail in cost estimates.

Master Comment 9.15

Commenters stated that the approach in the RI/FS is faulty because it incorporates an open-ended settlement with the PRPs and that this approach will maximize adverse economic impacts and create uncertainty regarding the final cost to area companies, and therefore strongly supports a "sum certain" settlement of this matter.

Response

Selection of a remedy for a site is based on its protection of human health and the environment. WDNR and EPA do consider the cost effectiveness of a remedy when choosing that remedy. That is, WDNR and EPA chose the remedy that will provide the needed level of protection for the least amount of money. The remedy for this Site is large and thus is very expensive, and as with any construction project, the costs will have uncertainty.

However, in negotiating the implementation of the remedy, the Agencies will consider several factors. First, WDNR and EPA always look at a company's ability to pay for the remedy or its share of the remedy. It is never the intent of WDNR or EPA, or in its interest, to cause serious economic disruption to a company's operations. A company isn't required to pay more than its ability to pay. Also, WDNR and EPA do and in this case will, consider cash-out settlement with companies. Companies that want the certainty of costs can approach the WDNR and EPA to see if the payment of a specific amount in a specific timeframe can be agreed upon.

It should be noted that the work would bring some economic benefits to the communities, with an influx of money in the form of living expenses of construction crews, local purchase of work-related materials, and subcontracting opportunities for local firms. There would also be economic benefits to the region related to environmental improvements. These would include tangible (e.g., restoration of commercial fisheries, decreased costs for navigation dredging, and increased tourism revenue), and intangible (e.g., quality of life and area "image") benefits.

Master Comment 9.16

Commenters noted that the paper industry represents 40 percent of the manufacturing base and is the single most important constituent of the regional economy. In addition, the area has experienced some economic dislocation (e.g., paper companies leaving the area).

Response

While there have been changes to the paper businesses in the Fox River Valley, these changes are not related to the proposed remediation of the River. Paper companies have never come to the WDNR or EPA and presented any written their evidence or stated at meetings that the cost to do this work is a factor in any of their business transactions, such as plant closing or layoffs in the Fox River Valley. Many of these business transactions have taken place at paper facilities that are not PRPs. It is the interest of the state and EPA that the Fox River Valley remains a strong economic base for the State of Wisconsin. WDNR and EPA do not anticipate this remediation creating economic problems. Please see *White Paper No. 17 – Financial Assessment of the Fox River Group*.

Master Comment 9.17

Commenters stated that the cleanup plan for the Lower Fox River and Green Bay should significantly reduce the human health risks and ecological risks without concern for what the PRPs can afford.

Response

WDNR and EPA believe that the remedy will significantly reduce risks in the Lower Fox River. This is discussed previously in the sections of this Responsiveness Summary dealing with risk and selection of the remedial action level. In addition, and as is stated above, the Agencies do consider several factors in negotiating with the PRPs and one of those factors is the company's ability to pay for the remedy or its share of the remedy. The Agencies are concerned with the economic health of the companies and the Fox River Valley. It is never the intent of WDNR or EPA, or in its interest, to cause serious economic disruption to a company's operations. WDNR and EPA don't require a company to pay more than its ability to pay. Also, WDNR and EPA do and in this case will, consider cash-out settlement with companies. Companies that want the certainty of costs can approach the WDNR and EPA to see if the payment of a specific amount in a specific timeframe can be agreed upon.

Master Comment 9.18

A commenter noted that people are concerned about the project costs, but they should compare these costs with other costs such as the new Packer Stadium – $1,272 per resident.

Response

Comment noted. It is the intent of the Agencies that the PRPs pay for the remediation, not taxpayers. However, WDNR and EPA also believe that a local solution, supported by local units of government, is one of the keys to keeping costs from increasing.

Master Comment 9.19

What are the health and medical care costs due to the current over-exposure to PCBs? And would a cleanup significantly reduce these costs? If we assumed that the associated costs due to exposure were one-half of 1 percent of the lifetime cost, that would come to $8,126,000,000 which is well over the cost of the project.

Response

The costs of health and medical care due to PCBs in the Lower Fox River are outside the scope of the RI/FS and BLRA.

Master Comment 9.20

Commenters expressed concern that long-term stewardship (similar to financial responsibility for landfills) should be required via performance bonds, irrevocable trusts or escrow accounts, insurance, or guarantees of net worth to accommodate any necessary remediation or perpetual care after rehabilitation is complete. Commenters also stated that long-term monitoring and maintenance costs over several centuries could easily exceed the short-term costs of a permanent solution (the PCBs and other toxic chemicals will not break down).

Response

The remedial action plan selected for each OU of the River will include performance measures and monitoring to assure that it achieves and maintains the cleanup goal. While the financial responsibility for landfills (i.e., WAC NR 520) would not be applicable for such cleanup activities as capping sediments, the WDNR does have the authority to require financial responsibility to pay for monitoring and long-term care of this type of project. Projected costs for long-term monitoring as well as contingency plans for maintenance and repair of the capping material would be included in the remedial action plan. In the event a cap would be placed in a portion of the River, the WDNR and EPA would also examine the need for further fiduciary responsibilities for the PRPs for long-term cap monitoring and maintenance.

9.3 Long-Term Monitoring

Master Comment 9.21

Some commenters believe that the draft Model Long-term Monitoring Plan (LTMP) included in the FS is overbroad and inconsistent with the NCP. In addition, some commenters believe that a simpler and effective monitoring plan should take into account the absence of other feasible remedial alternatives for the Bay; eliminate Zone 4 monitoring, eliminate bird tissue/eagle egg/blood plasma monitoring and limit monitoring to PCB trends in fish; eliminate observational surveys of mink habitat (already well characterized); and use data from existing monitoring programs whenever possible to avoid duplication of effort.

Response

WDNR and EPA believe that the draft Model LTMP is compliant with the NCP. The LTMP is consistent with the NCP in that it was developed as part of the Feasibility Study to confirm the effectiveness of the selected remedy to reduce risk to receptors from PCBs as well as other contaminants of concern. The LTMP is to be implemented for all OUs and will be modified in the remedial design stage to be consistent with the remedy selected for each individual OU.

The draft Model LTMP was drafted based upon a thorough and careful review of existing state, regional, and national monitoring programs. In addition, the LTMP took into consideration direct input from the resource agencies in the states of Wisconsin and Michigan, EPA, USFWS, NOAA, and the independent Menominee and Oneida nations. These resource agencies determined that given the magnitude of the PCB contamination in Green Bay, an MNR alternative could not be selected as the remedial alternative without a comprehensive, bay-wide program that monitors all important species, not just fish.

Master Comment 9.22

The comments submitted by the API Panel included recommendations for monitoring surface water, sediments, fish, and physical measurements of the River bottom and cap. They also offered that these monitoring elements need to be included the financial/institutional structure for operations and maintenance of all remedy components.

Response

The LTMP prepared by the API Panel appears to incorporate some of the same elements that are included in the draft Model LTMP developed as part of the FS. However, the API Panel's LTMP is sparse; both in terms of detail (e.g., fish species, age of fish, number of sediment samples, water samples), as well as in terms of the adequacy of sampling relative to the size of the proposed capping area. The API Panel's LTMP also does not include any reference to LTMPs developed and implemented at other cap sites (e.g., Eagle Harbor, Simpson Tacoma, Duwamish Waterway), or for that matter within the ARCS guidance documents. All of these plans incorporate sediment sampling, that evaluate contaminant migration or advective or diffusive flux, and native visual examination of the cap's physical integrity. The API Panel lists sediment sampling, but does not explain how they will collect samples from under the rock armored layer. *White Paper No. 6B – In-Situ Capping as a Remedy Component for the Lower Fox River* lays out the monitoring program for the *in-situ* capping that would be needed to monitor successful isolation for the Lower Fox River.

Master Comment 9.23

The API Panel suggested that the LTMP should focus on primary COCs (PCBs, mercury, DDE), but also consider additional COCs, with a final list developed in the final stages of remedy design. The API Panel also suggested that cores should be collected from the cap at 5 years and every 10 years.

Response

WDNR and EPA agree with many of the commenters' suggestions if a cap is chosen as part of the final remedy. However, the Agencies do not agree with the schedule proposed by the API Panel and believe more frequent monitoring of the cap is necessary to assure the integrity of the cap. A 10-year interval is not an acceptable frequency.

The general elements of the cap monitoring plan in the FS followed that described by Palermo et al. (1998), and relied specifically on the detailed monitoring plans developed for the Simpson Tacoma Cap, West and East, and West Eagle Harbor Superfund sites in Washington, and the Soda Lake Monitoring Plan in Casper, Wyoming. In each of those monitoring plans, sampling and analysis are more intensive in the first 5 years following construction, and thereafter decrease in frequency only if the cap integrity is maintained as expected. For example, core samples are collected through the cap into the underlying contaminated sediments every year for the first 5 years post-construction. Sections are taken from the core in order to determine if any migration of underlying contaminants has occurred. Specific operations and maintenance actions are tied to the presence of contaminants in order ensure permanent isolation of the contaminant(s). The plan presented in the FS is consistent with the plans listed and is very similar to that proposed by the API Panel. See also *White Paper No. 6B – In-Situ Capping as a Remedy Component for the Lower Fox River* for additional discussion.

Reference

Palermo, M. R., J. E. Clausner, M. P. Rollings, G. L. Williams, T. E. Myers, T. J. Fredette, and R. E. Randall, 1998a. *Guidance for Subaqueous Dredged Material Capping. Technical Report*. DOER-1. United States Army Corps of Engineers, Waterways Experiment Station, Vicksburg, Mississippi. Website: http://www.wes.army.mil/el/dots/doer/pdf/doer-1.pdf.

Master Comment 9.24

Several comments were received that suggested the draft Model LTMP contains insufficient detail, appears to contain a large amount of unnecessary and wasteful sampling and analysis, and is far too general to document achievement of the RAOs.

Response

The draft Model LTMP produced for the FS was not intended to be the working document for the implementation of monitoring. The Long-term Monitoring Work Plan, Sampling and Analysis Plan, and Quality Assurance Project Plan have been drafted and are undergoing final evaluation by WDNR, EPA, and the trustees. These documents, which are based upon the draft Model LTMP in the FS address the commenters' specific issues with the draft plan and contains the level of clarity and detail requested by the commenters.